A General Model of Simple and Complex Systems

By David Alderoty © 2015

Chapter 7) Open and Closed Systems, and Defining a System, in Terms of a Problem or Goal

Over 1,850 words

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THE FOCUS AND PURPOSE OF THE SYSTEM PERSPECTIVE PRESENTED IN THIS E-BOOK

To prevent confusion, I am placing the following statement at the beginning of each chapter in this e-book. Keep the ideas presented in the following three paragraphs, in mind as you read this e-book.

The main utility of a systems theory, especially the **General Model of Simple and Complex Systems,** is to assist in the study of systems, especially in terms of problem solving, goal attainment, and observational and experimental research. From a system perspective, all the relevant factors of a system are considered to obtain an objective. This can include the behavior and overall functionality of the system, its environment, its components, its structure, and related dynamics, cause-and-effect sequences, inputs, outputs, forces, energy, rates, time, and expenditures.

Examples of a system are atoms, molecules, chemicals, machines, electronic circuits, computers, planets, stars, galaxies, bridges, tunnels, skyscrapers, forests, rivers, streams, oceans, tornadoes, hurricanes, microorganisms, plants, animals, human beings, social groups, small businesses, organizations, political

parties, cultures, and the human mind of an individual, including related behaviors and personality traits.

A systems perspective is also useful for writing projects. This involves writing about all the relevant factors of a system, in terms of a thesis, or topic.

The purpose of this e-book is to discuss and explain the many details associated with the systems perspective described above. This required twelve chapters, which are relatively short.

Open and Closed Systems

What is an Open System?
General Model of Simple and Complex Systems

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Based on the way I am using the terminology, an open system is a dynamic system that interacts with its environment. This can include the exchange of one or more of the following:

1) information, **2) energy**, and/or **3) matter**. Any of the three factors might be controlled by feedback loops, based on environmental conditions, or the behavior of other systems.

Open systems may also interact with the environment, or other systems, in terms of locomotion, and/or work. The work in some cases can change the environment or other systems in the environment. In general the environment itself is also a system, which is usually opened.

Open systems, can be modified by environmental conditions. Other systems within the environment can change an open system, or destroy it. For example, environmental conditions that result in a shortage of food can change the appearance and behavior of animals living in the wild. Another example, is animals, sometimes destroy other animals to obtain food.

Human beings are good examples of open systems. They exchange information, energy, and matter, with the environment and the systems it contains. Humans also dynamically interact with the environment, and other systems. This includes, work, and the exchange of goods and services. Humans have various types of biologically related feedback loops, which control the input and output of matter (food, water, and wastes), and the production of energy.

What is a Closed System?

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Based on the way I am using the terminology a closed system has **limited** or **no** interactions with the environment. This includes **no** interactions with other systems in the environment. Closed systems have no significant exchange of information, energy, or matter with the environment. They have no feedback loops that are influenced by the environment. FFFFF In actual practice there are no systems that are entirely closed. However, there are systems that for all practical purposes can be treated as if they are closed systems. This is the case, when the exchange

with the environment is **not** significant for your objective, or for the problem you are trying to solve.

Static systems are usually defined as closed systems. For example, a rock can be treated as a closed static system. However, the rock varies in temperature, based on environmental conditions. This indicates that the rock is exchanging heat energy with the environment.

Some dynamic systems can also be defined as a closed system. For example a battery-powered electric clock can be treated as a closed system. However, the clock produces a little heat that is released into the environment.

A human being that is socially isolated, with minimal communication with others, can be defined as a closed system, from the perspective of a psychologist or social worker. However, any human system is exchanging matter and energy with the environment.

The idea to keep in mind, is that the concept of a closed system is relative, based on the way I am using the terminology. A system can be defined as closed, when its interactions with the environment is **not** relevant to your study. When the environmental interaction is relevant to your study, you defined the system as opened. The following paragraph will clarify this concept.

For example, if you are studying an isolated tribe of primitive people, you can define the system as closed, especially

in terms of the exchange of information, goods, and services, with the rest of the world. However, if you are studying the people of the tribe, and their interaction with their environment, you defined the system as opened.

Defining a System, in Terms of an Objective

Defining the System, in Terms of a Problem, Goal, Study, or Research Project

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The concept of a system is relative, and you must define it in terms of your objective, such as your problem, goal, study, or research project. These ideas are explained with examples in the following paragraphs.

If you are making a sundial to determine the time of day, you might define the system as the Earth revolving on its axis. However, if you are building a similar device to indicate the seasons you might define the system as the Earth orbiting around the sun.

Another example is if you are planning to buy a new car, the system that you are interested in is simply the car. However, if you were an electrical engineer that was hired to provide assistance with the design of a new car, you would probably define your job in terms of the electrical system of the car.

If you were studying the bird population in New York City, you would **not** define the entire city, and all its stores, roads and

buildings as your system. Your system would be the birds, their food source, and the structures that the birds use for shelter.

An Incorrect Definition of the System, Can Interfere with Solving a Problem, or Obtaining a Goal

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A major difficulty in problem solving, and goal attainment, is an incorrect definition of the system. The following four examples will clarify this concept.

1) A troubled or psychologically disturbed child The relevant system might be the child and her family, as opposed to the child. The relevant system in some cases might also include school.

2) An automobile that very frequently needs repair. The relevant system **might** be the driver, and the car, as opposed to the car. The system might also include the roads and local weather conditions.

3) Attempts to wipe out poverty have sometimes focused on money, education, or job training, with only marginal success. Perhaps, the system should be defined as inadequate educational facilities, with inadequate instructional strategies, the people, their neighborhood, culture, subculture, problems, as well as their inadequate financial resources, and an economic system that pays untrained workers excessively low wages.

Defining a System in an Excessively Narrow, or Broad Way Can Interfere with Problem-Solving and Goal Attainment

In general, a system can be defined in an excessively narrow way to solve a problem, or to obtain a goal. This involves a relatively small system, and excessively narrow focus, which may exclude important factors needed to achieve an objective. A system can also be defined very broadly, resulting in an excessively large system, which will include many factors that are irrelevant for obtaining an objective. However, most people will probably define a system in an excessively narrow way. This is because it greatly simplifies the efforts for problem solving and goal attainment, but this is likely to result in failure.

The obvious, but **incorrect** assumption is to compromise between the extremes mentioned above. The correct strategy is to evaluate the specific problem or objective, and define the system and related focus accordingly.

The above might be easier said than done, because very often we do not know all of the dynamics and factors that are directly and indirectly contributing to a problem, or interfering with goal attainment efforts. In such a case, it may be best to define the system based on the information you have available, or based on your intuition. **Then** you can increase or decrease the size of the system, based on the information you obtain during your problem solving efforts. This can involve a system that gets larger or smaller as more information is obtained.

To clarify the ideas presented above, let us assume for an example, that a factory has an excessively small rate of production, but an adequate number of employees. The system can be defined as one or more of the following: (Note the examples start with the smallest conceptualization of the system, and proceeds to the larger conceptualization.)

1) The system can be defined as the employees, which might involve adverse work habits and ethics of the employees.

2) The system can be defined as the employees, and the supervisors, which might include lack of supervision of the employees.

3) The system can be defined as the employees, supervisors, management, which might include inadequate assessments of the employees during the hiring process, and inadequate assessment of employee performance.

4) The system can be defined as the employees, supervisors, management, and the equipment. This can include inadequate or malfunctioning production equipment.

Defining Relevant Subsystems

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When working with a system, it is sometimes useful to define the relevant subsystems, based on the objective you are trying to achieve. When working on the problem the relevant subsystems are usually components that might be malfunctioning. When working on a scientific study, or experimental research project, all

of the identifiable systems might be defined. In addition, studies and experimental research might seek to identify new subsystems. For example, a study of an ecological system in the rainforests of South America, might involve a search for unidentified subsystems that are affecting the ecology of the system. This could include specific species of animals, waste dumping by the native population, unauthorized hunting by foreigners, or logging or mining operations.

Defining the System's Environment

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Systems exist in an environment, which can affect their functioning in positive, neutral, or negative ways. Some systems must have a specific environment to function, such as the following: Plants require an environment with proper soil and weather conditions. A business must be in a locality where it can obtain employees and customers. A manufacturing facility must be in a locality where it can obtain raw materials, employees, and economical shipping for the products it produces.

The environments often very in ways that affect the functioning of systems. These variations can destroy a system, cause malfunctions in a system, or result in a highly functional system, which may expand or grow. Examples are crops that are destroyed by unusual weather conditions, or a business that prospers when the weather conditions are favorable for skiing.

Some systems function in multiple environments, this includes people, certain species of migrating animals, automobiles, planes, and trains. Some of the environments can be problematic or hazardous for the system, and other environments might be favorable for a well-functioning system. Thus, when a system has multiple environments, it may be necessary to consider this factor for optimal problem solving and goal attainment efforts. For example, sometimes a student behaves dysfunctionally in the school environment, but functions very well in the home and social environments.

When examining the environment of the system, you must consider other entities in the environment. This includes competing or antagonistic systems, as well as supportive systems. For example, when considering the location of a business, you must consider potential competitors in the locality, as well as the availability of suppliers for the business.

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