

of warriors and the organization of armies) and epidemiological advantage (building immunities against diseases by close contact).

A third deduction from history is that, over time, the scale of human webs has tended to grow. So too has their influence on history. The current global web is truly worldwide. Practically no human society exists in isolation any more. The volume, velocity and importance of messages exchanged have become so large that their impact on contemporary society is incomparable to the effect of communication systems in ancient societies. This impact is a major reason for the emphasis of the network society concept in this book.

Finally, it has to be concluded that the power of human communication, both in its cooperative and competitive forms, has also affected the earth to an ever larger degree. Increasingly, economic and population growth, urbanization and technology have produced an ecological impact. 'We would not be 6 billion strong without the myriad of interconnections, the flows and exchanges of food, energy, technology, money that comprise the modern worldwide web' (McNeill and McNeill, 2003: 7).

NETWORKS AT ALL LEVELS

Networks of nature and society

What actually is a network? This question comes to mind after this broad description of networks in human history. After all, the concept appears in both natural and social sciences. Unfortunately, the following definition and account has to be rather abstract, but a precise definition and elaboration of the network concept here will enable better future understanding. A network can be defined as *a collection of links between elements of a unit*. The elements are called nodes. Units are often called systems. The smallest number of elements is three and the smallest number of links is two. A single link of two elements is called a relation(ship). Networks are a mode of organization of complex systems in nature and society.

In simple systems of nature and society, a static and hierarchical organization characterizes the relation of elements. For example, the relation between the elements or parts of atoms, molecules and chemical substances is fixed and has a particular order. Change means a transition to another (kind of) unit. When matter gets more complicated, especially when it becomes life, the elements have to be organized in more complicated ways. Life organizes these ways while it exchanges energy with the environment and adapts to this environment for survival. Networks are relatively complicated ways of organizing matter and living systems. They produce order out of chaos, linking elements in a particular way. Chaotic situations always appear as soon as the elements of matter and living systems become less fixed.

Emphasizing the organization and the relation of elements entails less attention to the elements and units themselves. The characteristics of units and elements, among them human individuals, and the way they are made up, are not the focus

of attention. Instead every network approach in the natural and social sciences stresses the relations of elements. It is opposed to atomistic views of reality and methodological individualism in research (measuring social reality by adding individual attributes).

So, networks occur both in complicated matter and in living systems at all levels (see Table 2.1). Buchanan (2002) mentions a couple of examples of physical networks. The first one is an ecosystem of earth surfaces, flora and fauna and the second one a river network organizing its downward water flow in branches adapting to the ground and all kinds of obstacles. Examples become more numerous in living systems. All organisms with many cells organize these cells in networks. When they become larger they create special (network) systems such as a nervous system and a blood stream. As a matter of fact, cells themselves contain networks. The most important one is the DNA string of genes (molecules). Nowadays it is common scientific understanding that the complexity of life is not determined by the number of genes but by their relationships.

The largest nervous system of organisms on earth is to be found in the human brain. An increasing number of neurobiologists and psychologists agree that the human mind works with neuronal networks that are organized on a higher level using mental 'maps' in particular regions of the brain. The connection between these maps (themselves being neuronal networks) also reveals a network form. Gerald Edelman, one of the best known of these neurobiologists, argues that even human consciousness emerges from such connections of mental maps (Edelman and Tononi, 2000).

Human beings have created social networks at least since the invention of speech, as was explained in the previous section. In these networks, the elements are social agents (individuals, groups, organizations and even societies at large) and the links are created by communicative (inter)actions. Below I argue that social networks figure at all levels and subsystems of society. In the course of history, humans have also created a number of technical networks. Examples are roads, canals, all kinds of distribution networks and the telecommunication and computer networks that are an important subject matter in this book. When the latter networks are filled

TABLE 2.1 Types of network

Physical networks	Natural systems of higher complexity: ecosystems, river networks
Organic networks	Organisms: nervous system, blood circulation, strings of DNA in cells
Neuronal networks	Mental systems: neuronal connections, mental maps
Social networks	Social systems with concrete ties in abstract relationships
Technical networks	Technical systems: roads, distribution networks, telecommunication and computer networks, etc.
Media networks	Media systems connecting senders and receivers and filled with symbols and information

with symbols and information to connect human senders and receivers, they become media networks.

This book is about the relationship between social, technical and media networks – together they shape the infrastructure of the network society. Even organic and neuronal networks receive some attention, for instance in Chapter 9, which discusses the psychology of new media use. However, the primary focus of attention is social networks supported by media networks.

Networks at all social levels

Social networks supported by media networks are available at all levels and subsystems of society. Four levels can be distinguished. They are portrayed in Figure 2.1, which shows the first picture of the abstract concept of the network society in this book.

The first and most basic level is the level of *individual relations*, not that of the individual because units and elements are not the prime focus of attention in a network perspective (Brass, 1995; Wellman and Berkowitz, 1988). This level corresponds to the common-sense meaning of (social) networking: individuals creating ties to

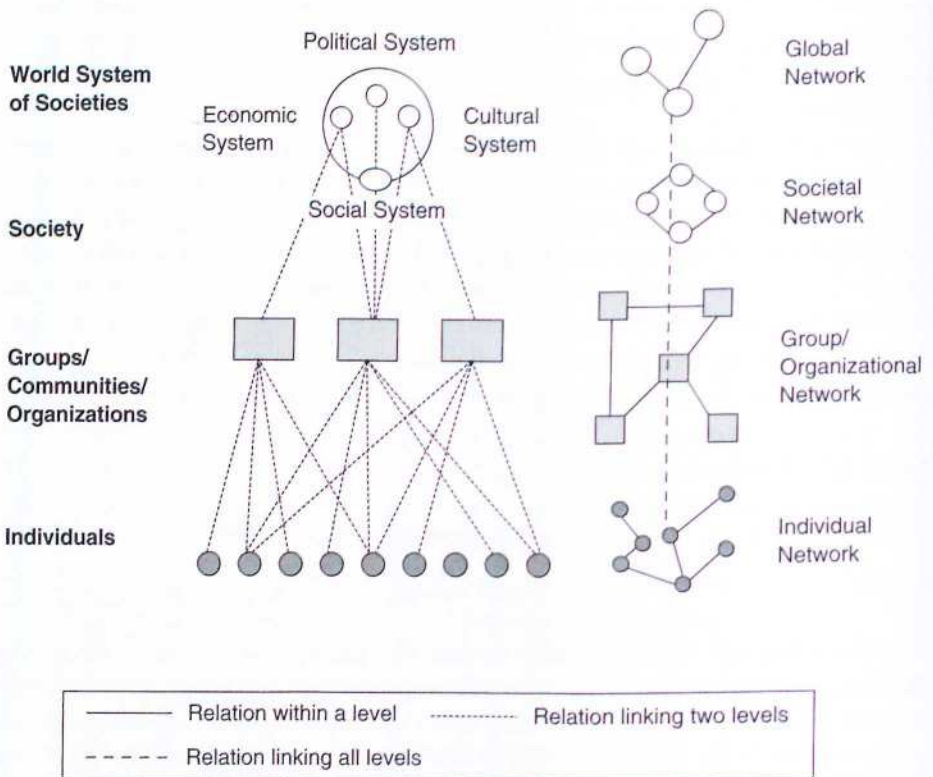


FIGURE 2.1 Four social units and levels linked by networks