Social explanations will emphasize the social need and appropriateness of the creation and use of networks at all levels. At the *individual* level we are witnessing the rise of networking as an explicit and increasingly systematic method of making contacts and improving social relations. Below, the concept of network individualization is used to describe this phenomenon. The use of networking is an evident social need in an individualizing society. Networks can be seen as the social counterparts of individualization. At the level of *organizations*, corporations and institutions are no longer working alone. They have become a part of a comprehensive division of labour. Increasingly, this division is organized in networks of cooperating organizations. Moreover, organizations have to open themselves more and more to their environment to survive in competition (business) and societal demand (government and non-profit organizations). Traditional internal structures of organizations are crumbling and external structures of communication are added to them. Acquiring new combinations of internal and external communication, they are better equipped to adapt to a swiftly changing environment.

Networks also cause a comprehensive restructuring of *society at large*. They are breaking old modes of organization as they help organizations in their search for new scale levels, new markets and new ways to govern and control. Networks link the processes of scale extension and scale reduction occurring simultaneously in modern society. At the one side they support globalization and socialization, and at the other side localization and individualization. In this way, they have accelerated modernization (Barber, 1996; Castells, 1996; van Dijk, 1993a).

All of these historical and social explanations are valid, but they fail to answer the question of why networks are built to satisfy these social needs. What is the presumed superior organizational quality of networks and networking? To answer these questions we have to dig deeper and consult network theory, a theory that has made considerable progress in the last fifteen years. Unfortunately, this means that the exposition has to become fairly abstract again.

Systems causes: Adaptation, evolution and managing complexity

Networks are structures and they organize systems. Network theory is usually some kind of structural theory and systems theory. The most general one is systems theory. In terms of this theory a network can be defined as *a relatively open system linking at least three relatively closed systems.* The relatively closed system is the unit. As we have seen, we need at least three of them to create a network. These units can be conceived as relatively closed systems because they contain elements that primarily act among themselves to reproduce the unit in a (pre)determined way. As soon as these closed units are forced, for one reason or another, to interact with their environment and to link themselves to other units in a network, they create an open system. In an open system, complete determination is lost and replaced by chance and random events. That allows change and new opportunities. This process of opening up closed systems is the secret of networks or networking as an organization principle.

This propensity of change is explained differently by two versions of systems theory that have inspired network theory. The first version has a biological inspiration and the second a physicist and mathematical inspiration. According to the biological inspiration, systems are conceived as organisms that have to adapt to a physical environment to survive (among others, Maturana and Varela, 1980, 1984; Prigogine and Stengers, 1984). This is the propensity of change here. In this reading, networks can be seen as adaptive systems. Our brain is a complex adaptive system and the same goes for our bodies. Increasingly, our organizations and societies are also complex adaptive systems. All of them are relatively closed. However, they have to adapt to an ever more complex environment. Here they get the assistance of networks as relatively open systems. According to Axelrod and Cohen (1999), adaptation occurs in three successive processes, which they derive from evolution (systems) theory: variation, interaction and selection. However, I think the right order in this theory is interaction, variation, selection and retention and I will treat them in this order.

First there is *interaction*. Networks support interactions within and between system units. For example, inside organizations they help to break through the divisions of departments to enable the communication of more members than before in shifting teams and projects. This offers them opportunities for changing and (self-)steering the organization. Between organizations, networks, particularly telecommunication and computer networks, are reducing the limits of time and place that were formerly keeping their members' communicative (inter)actions apart.

Increasing or intensifying interaction leads to more *variation*. First of all, there is variation of scope as the reach of information retrieval and communication is enlarged by new network connections. Everyone engaged in networking will recognize this idea: one has to break out of one's own small circle of people to obtain experiences and contacts outside, even when they are very superficial. Granovetter (1973) called this idea the strength of weak ties. Accepting the value of weak ties, one should not deny the importance of strong ties. Variation also reaches into depth. Our own familiar environment offers opportunities of interaction and information by means of intensive ties and high-quality communication. It is the combination of variation in scope and in depth that makes networks strong as relatively open systems emerging from relatively closed systems, but always remaining linked to them. A person engaged in networking is not a roaming nomad, but someone who keeps a home base.

The final process is *selection*. Here the goal of networking is reached: choosing the most successful actions and actors. This serves the adaptation and survival of the particular system concerned: *retention*. For example, an unemployed individual gets a job, a company finds the best chain of suppliers and customers and a society adopts a particular policy, organization and provision to uphold itself in the process of globalization.

The second version of systems theory reveals a mathematical and physicist inspiration. Here systems are conceived as units, both in nature and in society, containing elements that can be connected in ordered (clustered) and disordered (random) ways. Here the propensity to change is the tendency of nature to produce order out of chaos. For ages now, networks have been studied as mathematical objects called graphs. Graphs depict the potential links between a collection of elements in a particular unit. A social-scientific application is the discovery by the psychologist Stanley Milgram (1967) that on average every inhabitant (element) of a given unit, in this case the United States, is linked by six intermediary persons, in the so-called *six degrees of separation,* to every other inhabitant. This peculiar fact can only be explained by the other fact that groups of people are closely linked and organized in clusters. These clusters are often linked by so-called weak ties, a phenomenon described by the sociologist Granovetter (see above). In the tradition of Milgram and Granovetter, a number of mathematicians and physicists have made their way to social science to produce important discoveries in network theory that will be represented in the sections and chapters that follow (Barabási, 2002; Barabási & Albert, 1999; Buchanan, 2002; Watts, 2003; Watts and Strogatz, 1998).

This version of network and systems theory tries to explain how randomly distributed elements of a unit or system link to each other in clusters and these clusters in a single whole (a particular order). In this way, a complex system is created, in this case a complex society that is highly adaptable to environmental change. The question remains how order appears in a system without a pre-existing centre but with a number of interacting equals. The answer is connectivity: at a critical point, a phase

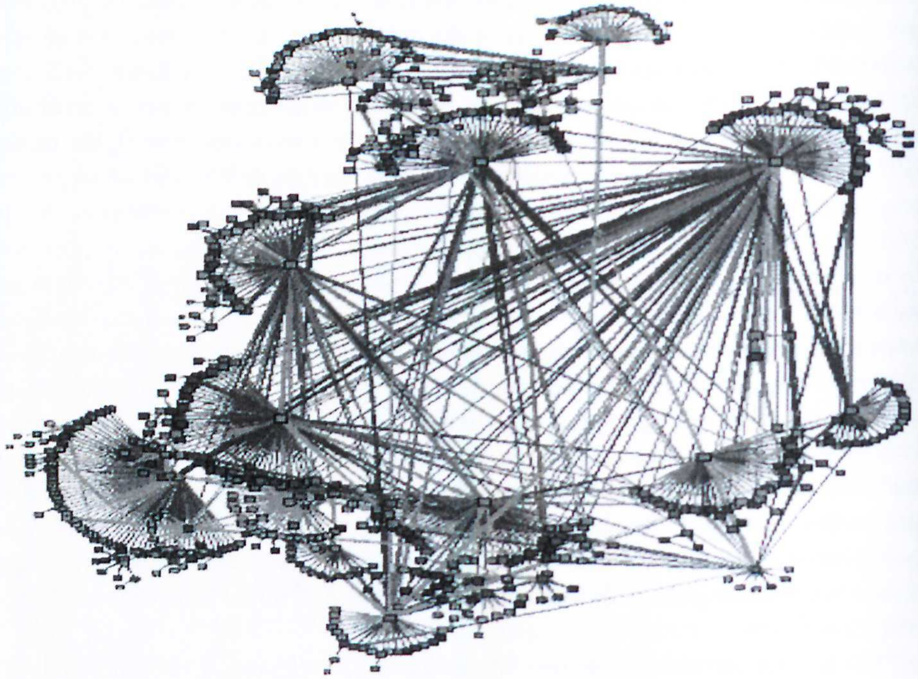

FIGURE 2.2 Picture of a network connecting small worlds (clusters)