Part I

Holism and Systems Practice

The aim of Part I is to provide the reader with the background information needed to understand fully the different systems approaches studied in Part II. Chapter 1 introduces the systems language and some simple systems ideas. It does this by tracing the influence of holism and the emergence of various systems concepts in some important intellectual disciplines, such as philosophy and biology. Chapter 2 considers the development of applied systems thinking since its birth around the time of the Second World War. It tries to put a pattern on events by seeing the different systems approaches that arose as responses, in turn, to the need to improve goal seeking and viability, to explore purposes, to ensure fairness, and to promote diversity. These various requirements themselves originate in the greater complexity, turbulence and variety of problem situations as discussed in the Preface. Chapter 3 steps back a little and sees the development of different systems approaches in terms of a willingness by systems thinkers to explore and enrich various metaphors of organization and alternative sociological paradigms using systems ideas. It is upon an understanding of this process, and of what different metaphors and paradigms have to offer, that the critique of the different systems approaches, exposing their strengths and weaknesses, can be launched in Part II.

The Systems Language

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> *The more we study the major problems of our time, the more we come to realise that they cannot be understood in isolation. They are systemic problems, which means that they are interconnected and interdependent.*
>
> Capra (1996)

1.1 INTRODUCTION

Simply defined, a system is a complex whole the functioning of which depends on its parts and the interactions between those parts. Stated like this, it is clear that we can identify systems of very different types:

- physical, such as river systems;
- biological, such as living organisms;
- designed, such as automobiles;
- abstract, such as philosophical systems;
- social, such as families;
- human activity, such as systems to ensure the quality of products.

The traditional, scientific method for studying such systems is known as reductionism. Reductionism sees the parts as paramount and seeks to identify the parts, understand the parts and work up from an understanding of the parts to an understanding of the whole. The problem with this is that the whole often seems to take on a form that is not recognizable from the parts. The whole emerges from the interactions between the parts, which affect each other through complex networks of relationships. Once it has emerged, it is the whole that seems to give meaning to the parts and their interactions. A living organism gives meaning to the heart, liver and lungs; a family to the roles of husband, wife, son, daughter.

It is not surprising therefore that there exists an alternative to reductionism for studying systems. This alternative is known as holism. Holism considers systems to be more than the sum of their parts. It is of course interested in the parts and particularly the networks of relationships between the parts, but primarily in terms of how they give rise to and sustain in existence the new entity that is the whole – whether it be a river system, an automobile, a philosophical system or a quality system. It is the whole that is seen as important and gives purpose to the study.

Holism gained a foothold in many different academic disciplines, benefiting from the failure of reductionism to cope with problems of complexity, diversity and change in complex systems. In what follows we look at the encounter of holism with philosophy, biology, control engineering, organization and management theory, and the physical sciences. We see how the systems language associated with holism was developed and enriched in each case. Particularly fruitful were the encounters with biology and control engineering, which gave birth to systems thinking as a transdiscipline, studying systems in their own right, in the 1940s and 1950s. This produced a language that describes the characteristics that systems have in common, whether they are mechanical, biological or social.

In a conclusion to the chapter I seek to explain why this language is particularly powerful for the purposes of managers.

More detailed accounts of the development of holistic thinking can be found in Checkland (1981) and Jackson (2000).

1.2 PHILOSOPHY

The classical Greek philosophers, Aristotle and Plato, established some important systems ideas. Aristotle reasoned that the parts of the body only make sense in terms of the way they function to support the whole organism and used this biological analogy to consider how individuals need to be related to the State. Plato was interested in how the notion of control, or the art of steersmanship (*kybernetes*), could be applied both to vessels and the State. Ships had to be steered safely toward harbour by a helmsman. A similar role needed to be fulfilled in societies if they were to prosper.

Holism was pushed to the margins of philosophical debate for many centuries, but the golden age of European philosophy, during the 18th and 19th centuries, saw a renewed interest in what it had to offer. Kant and

Hegel were particularly influential in this respect. Kant was an 'idealist' who argued that we could never really know reality or whether it was systemic. However, he believed it was helpful for humans to think in terms of wholes emerging from and sustained by the self-organization of their parts. Hegel introduced process into systems thinking. An understanding of the whole, or the truth, could be approached through a systemic unfolding of thesis, antithesis and synthesis. Each movement through this cycle, with the synthesis becoming the new thesis, gradually enriched our grasp of the whole.

It was these philosophical ideas that impacted on the scientific disciplines, where they were given a more rigorous formulation.

1.3 BIOLOGY

The fruitfulness of the relationship between holism and biology can be accounted for by the complexity of the problems encountered by biologists in trying to understand whole organisms. Whole organisms seemed to resist the attempts of scientific reductionists to reduce them to the sum of their parts. In the 1920s and 1930s, as a response to this, more holistically inclined biologists began to argue that organisms were more than the sum of their parts. They conceived that a hierarchy existed in nature – molecules, organelles, cells, organs, organisms – and, at certain points in the hierarchy, stable levels of organized complexity arose that demonstrated emergent properties, which did not exist at levels below. An organism was one such level.

It was argued that an organism (e.g., an animal) had a clear boundary separating it from its environment and was capable, as its main emergent property, of a degree of autonomy. An organism sustained itself in a steady state by carrying out transactions across this boundary with its environment. It had to be capable of making internal transformations to ensure that it was adapted to its environment. The processes that maintained the steady state were referred to as homeostatic, an example being the self-regulating mechanism controlling body temperature. The behaviour of an organism could not, it seemed, be explained by the properties of its parts in isolation. It arose from the particular interdependence of the parts, which gave rise to a new level of organized complexity. Biology was seen exactly as the science appropriate to this level and could not therefore be reduced to physics or chemistry.

Ludwig von Bertalanffy has become the best known of the biologists who argued that organisms should be studied as complex wholes. In 1950 he published an article in which be made the well-known distinction between closed systems and open systems. A closed system engages in no exchanges with its environment. An open system, such as an organism, has to interact with its environment to maintain itself in existence. Open systems take inputs from their environments, transform them and then return them as some sort of product back to the environment. They depend on the environment for their existence and adapt in reaction to changes in the environment.

Von Bertalanffy's lasting fame and influence has derived from his suggestion that the sorts of behaviour he witnessed in open systems in biology could be seen demonstrated by open systems in other domains. Thus, he initiated and named 'general system theory' (see von Bertalanffy, 1968) – a kind of transdiscipline in which systems were studied in their own right and which allowed insights from one discipline to be transferred to others. General system theory was soon embraced by management thinkers who transferred the open system model to their study of organizations.

The biological system model is represented in Figure 1.1. It shows a system separated from its environment by a distinct boundary. The system has a complex structure, being differentiated into subsystems that themselves have parts (systems arranged in a hierarchy of systems). The close interrelationships of mutual influence between the subsystems must ensure homeostasis – the maintenance of a steady state. One subsystem is acting in a kind of 'management' capacity, trying to ensure integration and co-ordination. The system takes inputs of material, energy and information

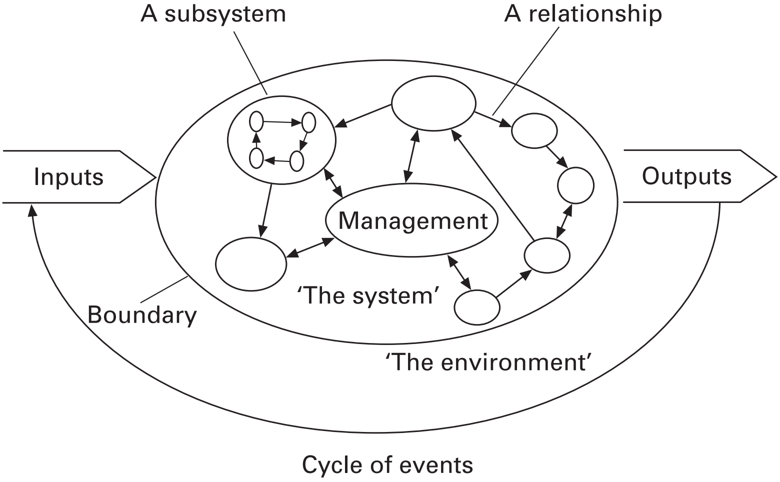

Figure 1.1 The biological system model.

from its environment, uses some to sustain itself and transforms the rest into outputs. These outputs may themselves allow the system to secure, through a cycle of events, more of the useful inputs it needs to survive.

The open systems perspective propounded by von Bertalanffy, and so influential in the 1970s and 1980s, has more recently been challenged by the biologists Maturana and Varela (1980). They emphasize instead the closed system of interactions that occurs in living entities. These interactions ensure the self-production of the system and its autonomy. Such self-producing, or *autopoietic* (from the ancient Greek for self-production), systems respond to environmental disturbances, but not directly or simply; the nature of the response depends on their own internal organizational arrangements. This does not mean that autopoietic systems cannot change their structure, but it does mean that they do this only with a view to keeping their fundamental organizational identity intact. The emphasis on the circular organization of living systems, and their resistance to change, offers a useful corrective to those general system theorists who stress the overriding importance of organization–environment relations.

1.4 CONTROL ENGINEERING

The other figure who stands alongside von Bertalanffy, as a founding father of systems thinking as a transdiscipline, is Norbert Wiener, a mathematician and control engineer. In 1948 Wiener published a book on what he called, borrowing from the Greek, cybernetics – the science of control and communication in the animal and the machine. Cybernetics, Wiener argued, was a new science that had application to many different disciplines because it dealt with general laws that governed control processes whatever the nature of the system under consideration.

The two key concepts introduced by Wiener into the systems lexicon were control and communication. In understanding control, whether in the mechanical, biological or political realm, the idea of negative feedback is crucial. This concept allows a proper, scientific explanation to be given of purposive behaviour – behaviour directed to the attainment of a goal. It was Wiener's insight that all such behaviour requires negative feedback. In this process, information is transmitted about any divergence of behaviour from a present goal and corrective action taken, on the basis of this information, to bring the behaviour back towards the goal. In a central heating system a thermostat monitors the heat of a room against some preset temperature and uses the information that the temperature is too low or high to switch

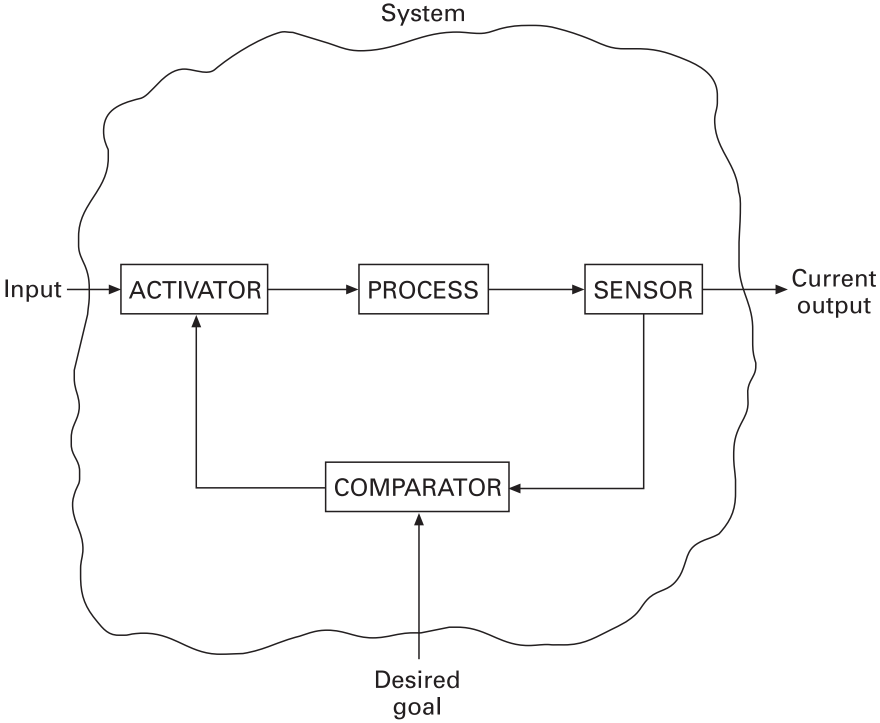

Figure 1.2 A negative feedback system.

the system on or off. Communication is equally significant because if we wish to control the actions of a machine or another human being we must communicate information to that machine or individual.

Figure 1.2 shows a simple, negative feedback system. It operates by sensing the current output of the process that is to be controlled. The output is compared with the desired goal and, if it diverges from this, an activator adjusts the input to bring the process back toward achieving the desired goal. In this way, systems regulate themselves and are controlled, in the face of environmental disturbances, through the effective communication of information. It is of course very important that the sensor and comparator operate continuously and rapidly. This ensures that discrepancies are identified at the earliest possible opportunity and corrective action can immediately be initiated. It is also worth noting that it is not necessary to understand the nature of the process, which might be a complex system, in order to employ the negative feedback device. The controller can regard it as a 'black box' and adjust it simply by manipulating the inputs in order to achieve the desired outputs.

Although it did not impinge much on the consciousness of Wiener, another form of feedback, positive feedback, has become significant for systems thinking. While negative feedback counteracts deviations from a goal, positive feedback amplifies them. For example, one mistimed tackle in a soccer match can lead to a series of deliberate fouls, escalating into uncontrolled aggression from both sides. Identifying situations where the parts of a system are locked into a positive feedback loop, and its behaviour is spinning out of control, is of obvious significance to managers. A good referee can re-establish order with the astute use of a yellow card.

A final systems concept that I need to introduce in this section is 'variety'. Variety is a term first used by Ashby (1956) to refer to the number of possible states a system can exhibit. According to Ashby's law of requisite variety, systems can only be controlled if the would-be controller can command the same degree of variety as the system. Today, systems are complex and change rapidly; they exhibit high variety. Managers need to pay attention to reducing the variety of the system they are seeking to control and/or to increasing their own variety. This process of 'balancing varieties' is known as variety engineering. We shall see how it is done in Chapter 6.

1.5 ORGANIZATION AND MANAGEMENT THEORY

Early attempts to marry holism with organization and management theory took two main forms. In the first some basic systems concepts were incorporated in the prevailing scientific management tradition to yield optimizing approaches, such as systems engineering. In the second there was a wholesale transfer of the biological analogy, especially as refined by von Bertalanffy, to yield systems models of organization emphasizing the importance of subsystems to overall organizational effectiveness and the significance of the organization–environment fit.

Both these early attempts met with difficulties because they failed to recognize that systems containing human beings are, what we now call, purposeful. The systems of components that engineers are used to dealing with are purposive – designed to reach the goal specified by the engineers. Biological systems are adept at survival, but if this is their purpose it is obviously something ascribed to them from the outside and not something they think about themselves. The parts of social systems however – human beings – can generate their own purposes from inside the system, and these might not correspond at all to any purposes prescribed by managers or outsiders. Social and organizational systems, therefore, have multiple purposes: they are purposeful.

It was soon clear that a different kind of terminology would be useful for describing and working with purposeful systems.

A number of roles had to be delimited relevant to purposeful systems and reflecting some alternative sources of purposes. The term ‘stakeholder’ is used to refer to any group with an interest in what the system is doing. Decision-makers or owners have the power to make things happen in systems; actors carry out basic tasks; customers or clients benefit or suffer from what a system does. Problem-owners worry about the performance of some aspect of a system. Witnesses are affected by systems but unable to influence their behaviour. Problem-solvers or analysts take on board the task of trying to improve systems.

Since purposes emanate from the human mind, attention also has to be given to the different mental models that people bring to their roles. These mental models are made up, in each case, of a mix of the understanding and values that individuals have gathered through their experiences and education. The facts and values that they use in interpreting the world can perhaps themselves be understood in systems terms. They are said to constitute the world view, *Weltanschauung* (a German word meaning ‘world image’), or appreciative system employed by an individual or group.

For those who want to manage purposeful systems or intervene to change them the resistance, or otherwise, of *Weltanschauungen* or appreciative systems to change becomes critical. If the only change that can be contemplated takes place in the context of an existing mental model, then you are limited to bringing about first-order learning. If, however, the mental model itself can be changed, and purposes radically altered, then second-order change is possible. The ways in which world views change became a primary focus of ‘soft systems thinking’ and, within this, Hegel’s notion of a ‘dialectical debate’ between thesis and antithesis was particularly influential.

Finally, in considering purposeful systems, we need to note how significant the concept of boundary becomes. With a machine or organism it is usually very apparent where the boundary of the system lies. For those concerned with purposeful systems, however, this is rarely the case. Where the boundary is seen to be will depend on the world view of the person observing the system. For example, whether the boundary of a business organization should expand to include its natural environment, its local community, unemployed people, etc. are all very much issues open to debate. Values and ethics play a part in such decisions. There is the further matter of who should participate in defining purposes, taking decisions and drawing boundaries. And because resources and interests will be at stake, as well as different philosophies, power and politics will have a significant impact on purposeful systems.

The encounter of holism with management and organization theory has thrown up complications not found when the focus of attention for systems thinking was the natural realm. Part II reveals, however, that this has not been an unequal challenge; holism has stood up to the task well enough.

1.6 THE PHYSICAL SCIENCES

Systems thinking emerged as a transdiscipline, in the 1940s and 1950s, in large part as a reaction to the reductionism of the traditional scientific method and the failure of that reductionism to cope with the complexity inherent in the biological and social domains. It seemed for some time, therefore, that systems thinking was the antithesis of the scientific method. More recently, however, the physical sciences seem to have undergone their own systems revolution and holism, and the concepts associated with it have been welcomed in physics and chemistry as offering new forms of explanation and new avenues of exploration. Quantum theory in physics and the study of dissipative structures in chemistry are examples of a more holistic orientation in the physical sciences.

Because they have undergone their own systems revolution, the physical sciences are now able to make their own contributions to the language of systems thinking more generally. Quantum physics brought to the fore the notion of indeterminacy and gave new meaning to the concept of relationships. From chemistry comes a reinforcement of the process view of systems and the idea of self-organization. Perhaps most important of all, however, has been the birth of a new kind of general system theory in science under the banner of chaos and complexity theory (see Gleick, 1987).

Complexity theory – the more general term and the one we shall use – complements the normal systems concern for order by being equally concerned with disorder. The fact that so many complex systems appear to exhibit disorder, irregularity and unpredictability had seemed to put them beyond the reach of scientific understanding. Complexity theorists did not actually dispute this. Indeed, their early studies reinforced the notion by demonstrating that a small change in the initial conditions of a system can lead to large-scale consequences later on: famously, a butterfly flapping its wings in the Amazon jungle can conceivably lead to storms in the South

China Sea. However, what they also found was that underlying apparent chaos was a surprising degree of pattern. Complex systems seem to be governed in some way by ‘strange attractors’, which means that although they never repeat exactly the same behaviour, what they do remains within certain limits. The weather in England is notoriously unpredictable in detail, but we never experience extreme cold or extreme heat and, only occasionally, very heavy rainfall and hurricanes. Furthermore, the patterns that govern complex systems seem to be repeated at different levels of the system. The parts of the whole are similar in shape to the whole. Snowflakes and cauliflowers have been used as everyday examples of ‘fractal wholes’ demonstrating such self-similarity.

Pursuing their research into order and disorder in complex systems, complexity theorists discovered what became known as the ‘edge of chaos’. This is a narrow transition zone between order and chaos where systems become capable of taking on new forms of behaviour – of self-organization and particularly innovative activity.

The potential of complexity theory for helping managers is perhaps becoming clear. The organizations they manage seem chaotic and unpredictable. But maybe they too are governed by strange attractors that can, after all, be understood. The environments in which organizations operate are turbulent and ever changing, yet organizations seem slow to adapt. Maybe if they can be driven to the edge of chaos they will be much more creative in the way they behave. A new systems view of organizations has been constructed out of these ideas.

1.7 WHY IS THE SYSTEMS LANGUAGE SO POWERFUL?

In this chapter we have started to become familiar with the systems language. Our undertstanding will be deepened as we start to see how the language can be used to address management problems in Part II. Obviously, it takes effort to learn a new language and we will have to encounter still more new concepts in what follows. In asking you to make this effort I can perhaps rely on the fact that managers are fed up with being offered simple solutions to complex, diverse problems. They recognize that more sophisticated solutions are necessary and that this may demand a more difficult language. I am keen, however, to close the chapter with just four arguments as to why you should bother with the systems language.

First, as we have seen, the emphasis on holism offers a useful corrective to the reductionism that still governs much management thinking. Organizations are complex and the relationships between the parts are crucial. There is a need for joined-up thinking in addressing their problems.

Second is the emphasis modern systems thinking puts on process as well as structure. This stems from systems philosophy, from von Bertalanffy's open systems concept and from complexity theory. It is not always the right approach to design systems according to some predefined blueprint. Allowing a process to take place can lead to innovative behaviour and ways forward that could not have been foreseen before the process was embarked on.

Third is the transdisciplinarity of systems thinking. It draws its ideas and concepts, as we have seen, from a variety of different disciplines and in so doing can draw on their different strengths. Even if analogies derived from physics and biology do not hold strictly when applied to organizations, managers have access to a rich storehouse of insights if they can use other disciplines to provide them with new metaphors for understanding their role.

Finally, the systems language has proven itself more suitable for getting to grips with real-world management problems than that of any other single discipline. It has given rise to a range of powerful systems approaches to management. The next chapter starts to look at the development of this applied systems thinking. In Part II you will get the chance to judge the truth of the claim I am making here for yourself.

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