# Paul Cilliers

Paul Cilliers lectures in philosophy at the University of Stellenbosch, South Africa. His book "Complexity and Postmodernism" (published by Routledge in 1998) is a very clear, yet provocative account of complexity thinking and its relationship to post-structuralism. I would recommend it to anyone wishing to delve more deeply into the philosophical ripples emanating from the ideas of complexity.

In his book, he offers the following characteristics of complex systems:

1. Complex systems consist of a **large number of elements**. When the number of elements in a system becomes sufficiently large, conventional means not only become impractical, they also cease to assist in any *understanding* of the system.

2. A large number of elements are necessary, but not sufficient. The grains of sand on a beach do not interest us as a complex system. In order to constitute a complex system, **the elements have to interact**, and this interaction must be dynamic. A complex system changes with time. The interactions do not have to be *physical*; they can also be thought of as the transference of *information*.

3. The **interaction is fairly rich**, i.e. any element in the system influences, and is influenced by, quite a few other ones. The behaviour of the system, however, is not determined by the exact amount of interactions associated with specific elements. If there are enough elements in the system (of which some are redundant), a number of sparsely connected elements can perform the same function as that of one richly connected element.

4. The interactions themselves have a number of important characteristics. Firstly, the interactions are ***non-linear***. A large system of linear elements can usually be collapsed into an equivalent system that is very much smaller. Non-linearity also guarantees that small causes can have large results, and vice versa. It is a precondition for complexity.

5. The **interactions usually have a fairly short range**, i.e. information is received primarily from immediate neighbours. Long-range interaction is not impossible, but practical constraints usually force this consideration. This does not preclude wide-ranging *influence* - since the interaction is rich, the route from one element to any other can usually be covered in a few steps. As a result, the influence gets modulated along the way. It can be enhanced, suppressed or altered in a number of ways.

6. There are loops in the interactions. The effect of any activity can feed back onto itself, sometimes directly, sometimes after a number of intervening stages. This feedback can be positive (enhancing, stimulating) or negative (detracting, inhibiting). Both kinds are necessary. The technical term for this aspect of a complex system is ***recurrency***.

7. Complex systems are usually open systems, i.e. they interact with their environment. As a matter of fact, it is often difficult to define the border of a complex system. Instead of being a characteristic of the system itself, the scope of the system is usually determined by the purpose of the *description* of the system, and is thus often influenced by the position of the observer. This process is called ***framing***. Closed systems are usually merely complicated.

8. Complex systems operate under conditions **far from equilibrium**. There has to be a constant flow of energy to maintain the organisation of the system and to ensure its survival. Equilibrium is another word for death.

9. **Complex systems have a history**. Not only do they evolve through time, but their past is co-responsible for their present behaviour. Any analysis of a complex system that ignores the dimension of time is incomplete, or at most a synchronic snapshot of a diachronic process.

10. Each element in the system is ignorant of the behaviour of the system as a whole, it responds only to information that is available to it locally. This point is vitally important. If each element 'knew' what was happening to the system as a whole, all of the complexity would have to be *in that element*. This would either entail a physical impossibility in the sense that a single element does not have the necessary capacity, or constitute a metaphysical move in the sense that the 'consciousness' of the whole is contained in one particular unit. **Complexity is the result of a rich interaction of simple elements that only respond to the limited information each of them are presented with**.

Another lovely (and slightly frivolous) illustration of the nature of complexity given by Cilliers is this:

"I have heard it said (by someone from France, of course) that a jumbo jet is complicated, but that a mayonnaise is complex."

And a sound bite on complexity from Cilliers (with apologies to him for presenting it in this way...):

"A complex system cannot be reduced to a collection of its basic constituents, not because the system is not constituted by them, but because too much of the relational information gets lost in the process."