

# **KNOWING COMPLEX SYSTEMS**

## **THE LIMITS OF UNDERSTANDING**

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**What is complexity?**

**Characteristics of complex systems**

**Models of complex systems**

**What is knowledge?**

**Knowledge, information and meaning**

**Tackling Complexity**

## CHARACTERISTICS OF COMPLEX SYSTEMS

1. They consist of a large number of (often simple) components.
2. These components interact dynamically.
3. The interaction is usually quite rich.
4. The interaction is non-linear.
5. No direct link necessary for distant elements to interact – other elements mediate.
6. There is an abundance of (non-linear) feedback routes.
7. Complex systems are open systems.
8. They operate under conditions far from equilibrium.
9. The history of a system is vitally important.
10. Subcomponents of the system cannot have access to all the information in the system, they can only react to local information.  
The behaviour of the system as a whole is a relational (emergent) property. (Denying the homunculus).

## **SOME CONSEQUENCES**

1. Complexity is not reducible. Since the structure of a complex system is organised non-linearly, it cannot be compressed. (Causality is upheld, but effects cannot be tracked deterministically.)
2. If the system is complex (in the incompressible sense) it cannot be described accurately by a limited set of abstract rules.
3. The structure of complex systems are not arbitrary, nor “chaotic”. (Even the concept “on the edge of chaos” could be misleading.)

## MODELS OF COMPLEX SYSTEMS

Reducing complexity is what they do

We cannot have perfect models of complexity (complex models will be as difficult to understand as the systems they model)

We *have* to make models in order to *understand* complexity

Models have to be revised and transformed (deconstructed) continuously.

## WHAT IS KNOWLEDGE?

Can we have “knowledge” of a distributed system?

(What is “in” the brain?)

The traces in a distributed system can be information, but  
is not “knowledge”

Knowledge is situated in a subject, and is something which  
can be coherently communicated, i.e. knowledge is  
the result of a model, and models are limited

## **INFORMATION, KNOWLEDGE AND MEANING**

Computerised and mathematical formalisations leads to an  
abstract understanding of information, however,

Knowledge is always “interpreted” information

Knowledge has to be a reduction of distributed complexity

Knowledge is always contextualised,

and always has a temporal dimension

Knowledge is “embodied”

(Is formal knowledge “knowledge”?)

Knowledge is necessarily incomplete, and this is a stroke  
of luck: postulating completeness leads to relativism!(or  
contradiction)

We cannot have knowledge without limits

“Knowledge” always has a narrative component

## TACKLING COMPLEXITY

Complex systems are not chaotic, they are often robust,  
thus we need not dismiss ways of dealing with the  
world which have been useful in the past

However, they are non-linear and their behaviour cannot  
be predicted with confidence.

When we do this, two factors are vital:

Experience

Imagination

There is thus a vital role for art and the human sciences  
alongside the natural sciences

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