On the Role of Designing in Complex Adaptive Systems

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Some Terms and Concepts

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Closed and open systems

Equilibrium and stability

Simple, complicated, and complex systems

Dissipative structures and complex adaptive systems

Some Terms and Concepts

Closed

Equilibr

Simple,

Dissipa
systems

Closed system: no external forces and no flows across its boundary

Open system: external forces and flows across its boundary

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Equilibrium: all forces and flows sum to zero and/or entropy production is zero

Stability: tendency to preserve a particular state: near to equilibrium systems; self-organising systems

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Simple systems: a few linear elements with linear interactions; no need to decompose to understand them

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Complicated systems: many (differentiated) managed and controlled elements with controlled interactions; decomposable and behaviour is sum-of-parts

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Complex systems: very large number of (same or differentiated) variable elements with non-linear behaviour and/or non-linear interactions; self-organising and emergent behaviour

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Dissipative structures: Ilya Prigogine's theory of far-from-equilibrium thermodynamics and its principle of maximum entropy export as an account for how open dissipating systems self-organise stable structures

A theoretical but controversial account of self-organisation

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Complex Adaptive Systems (CAS): cf Kauffman, Holland, Gell-Mann and others: very large number of self-adapting agents (elements) with non-linear behaviour and non-linear interactions

A commonly accepted characterisation of self-organising systems, but no theoretical account

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Are cities dissipative structures, or just somehow analogous to them?

Is the Inernet a CAS, or does it just share some CAS characteristics?

Are healthcare systems homologues of CASs, or of far-from-equilibrium systems?

Designing in ...

Designing in ...

Simple systems

Designing in ...

Simple

Designing simple systems ...

design everything and

put it all together

Designing in ...

Simple systems

Complicated systems

Designing in ...

Simple

Compli

Designing complicated sytems ...

design each component and

assemble sub-systems and

incrementally construct complete systems

Designing in ...

Simple systems

Complicated systems

Complex Adaptive Systems

Designing in ...

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Designing Complex Adaptive Systems ...

?

Designing in ...

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Designing changes to CASs ...

Design a very large set of self-adapting elements with non-linear interactions that *change* the self-organising emergent behaviour of the complete system

An Example: Cities and Towns

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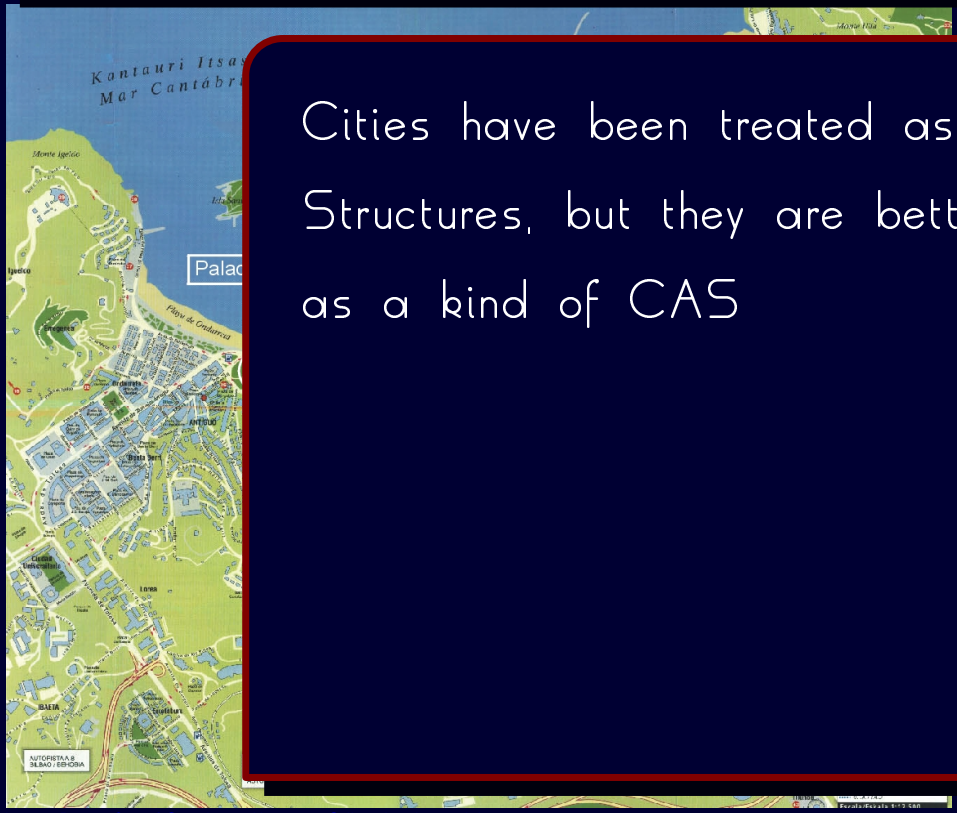

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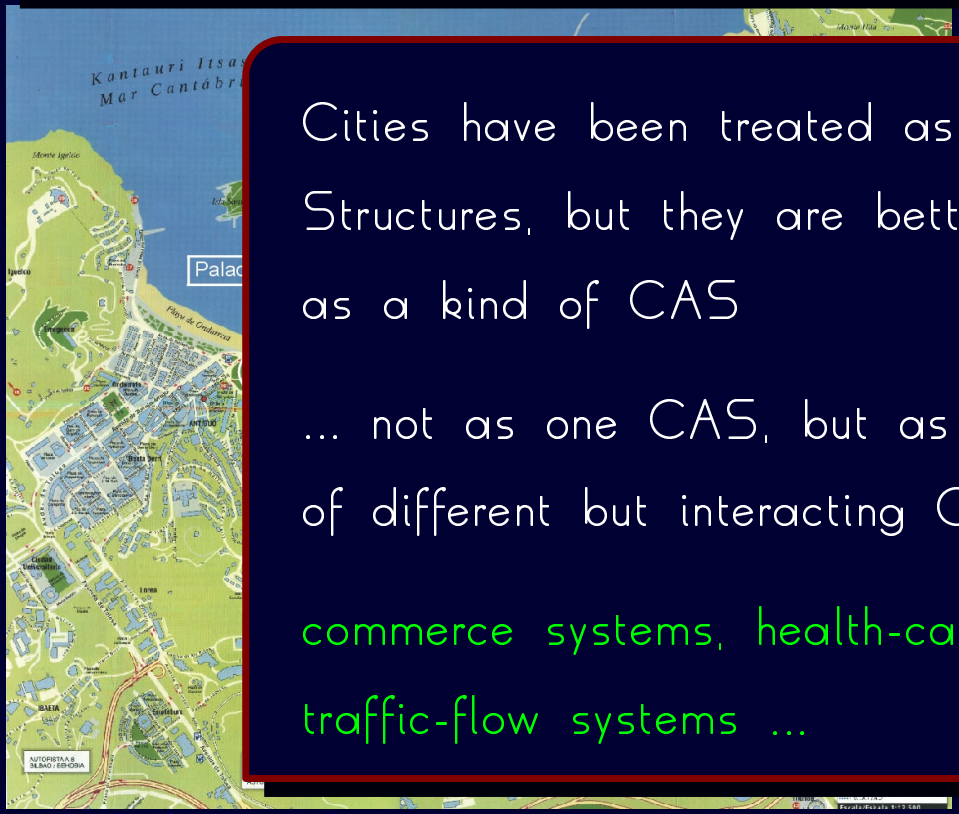

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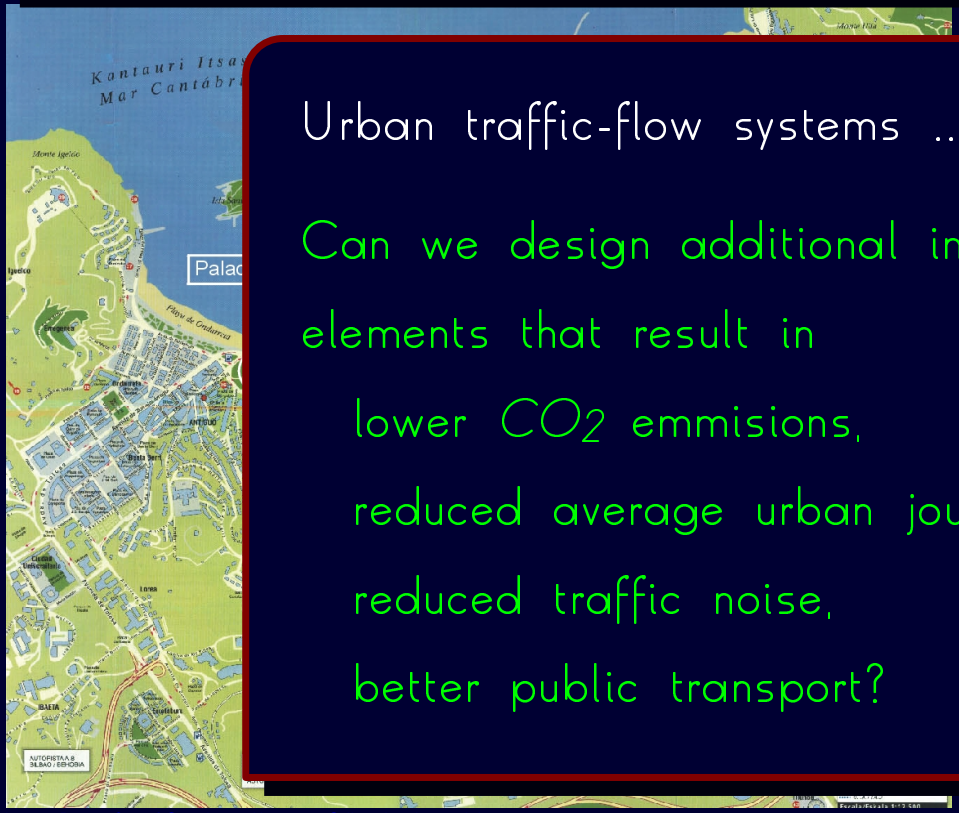
commerce systems, health-care systems, traffic-flow systems ...

An Example: Cities and Towns



Urban traffic-flow systems ...

Can we design additional interacting CAS elements that result in

- lower CO_2 emmisions,
- reduced average urban journey times,
- reduced traffic noise,
- better public transport?