From the molecule to the ecosphere

Digital Campus of Complex Systems partners

Institut of Complex Systems, Paris île-de-France (ISC-PIF)

Region of Île-de-France

Complex Systems Society (CSS)
UNESCO
CSS

French Network of Complex Systems (RNSC-France)

WHAT ARE THE COMPLEX SYSTEMS?

Complex systems consist of a large number of heterogeneous entities which interact locally and bring about multiple levels of structure and organisation.

Evolution selects organisations which are stable, robust, coadapted and have architectures observable on the long term. Complex systems, either artificial or natural, are everywhere, but there are no methods or formalisms to build integrated predictive models. We can no longer be content with knowledge of components without understanding how they come together as a whole. A new understanding, based on integrated modelling is required. The science of complex systems aims at filling the gap which separates modelling from data collection and theoretical from experimental disciplines.
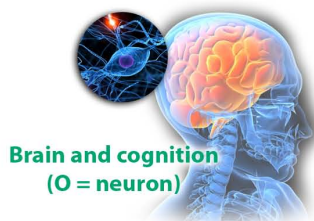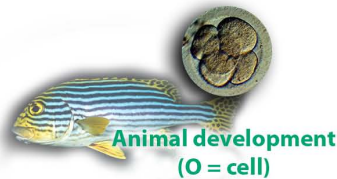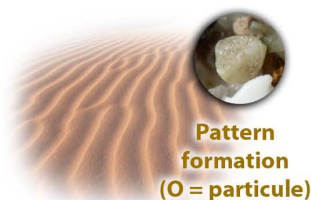
TO STUDY COMPLEX SYSTEMS:

THE COMPLEX SYSTEMS DIGITAL CAMPUS WITH ITS:

•DIGITAL UNIVERSITY
•DIGITAL INSTITUT

All things being in a chain of influence and in a chain of causes, I deem it impossible to know the whole without knowing the parts nor to know the parts without knowing the whole.

Blaise Pascal – Pensées

Physical, biologicals, social & technologicals systems

Pattern formation
(O = particule)

Animal development
(O = cell)

Insects colonies
(O = hormiga)

Brain and cognition
(O = neuron)

Socials networks
Social cognition
(O = individual)

Internet & Web
(O = host / page)

THE COMPLEX SYSTEMS DIGITAL CAMPUS (CSDC)

In the age of ubiquitous information and communication training and personalised education can be accessible to all.

This infrastructure with new kinds of remote teaching and learning will allow interdisciplinary communities to share knowledge, concepts, methods and tools necessary to build integrated models.
Its goal is:
personalised education in the framework of complex system coursus.
It will provide:
-multimedia library of teaching materials supplied by teachers, researchers and students autoadapted to the needs of individuals and groups: its content will develops in proportion to the number of research projects of the various users.
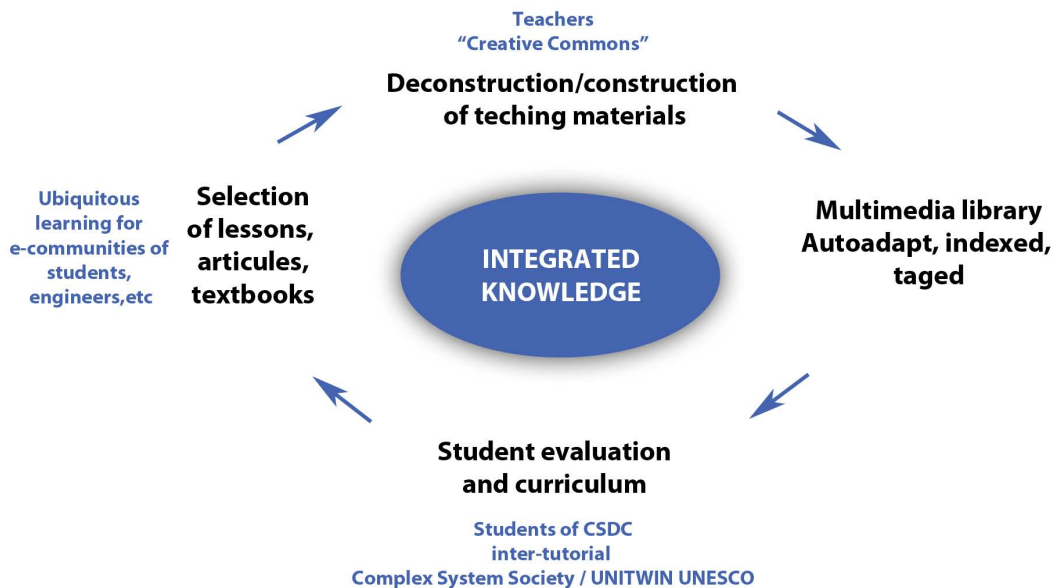*-automatic mapping of scientific domains to provide integrated knowledge of sciences.*
-continuous support for students, provided by student tutors in virtual networks of teaching and learning support.

BUILD A GLOBAL POSITIONING SYSTEM (GPS) OF INTEGRATED KNOWLEDGE OF COMPLEX SYSTEMS

Tell me and I forget,
Teach me and I remember,
Involve me and I learn.

Benjamin Franklin

TOWARDS A PERSONALICED EDUCATION

Teachers
"Creative Commons"

Deconstruction/construction of teching materials

Ubiquitous learning for e-communities of students, engineers,etc

Selection of lessons, articules, textbooks

INTEGRATED KNOWLEDGE

Multimedia library Autoadapt, indexed, taged

Student evaluation and curriculum

Students of CSDC
inter-tutorial
Complex System Society / UNITWIN UNESCO

COMPLEX SYSTEMS: THINK DIFFERENTLY

COMPLEX SYSTEMS DIGITAL INSTITUTE

Research infrastructures to share multiscale experimental protocols, the data and the computational protocols

The complex systems digital Institute develops as a large infrastructure of integrated models, based on distributed infrastructures dedicated to multiscale observation of complex systems.

IT WILL BE POSSIBLE TO OBSERVE THE COMPLEX SYSTEMS IN VIVO AND IN TOTO

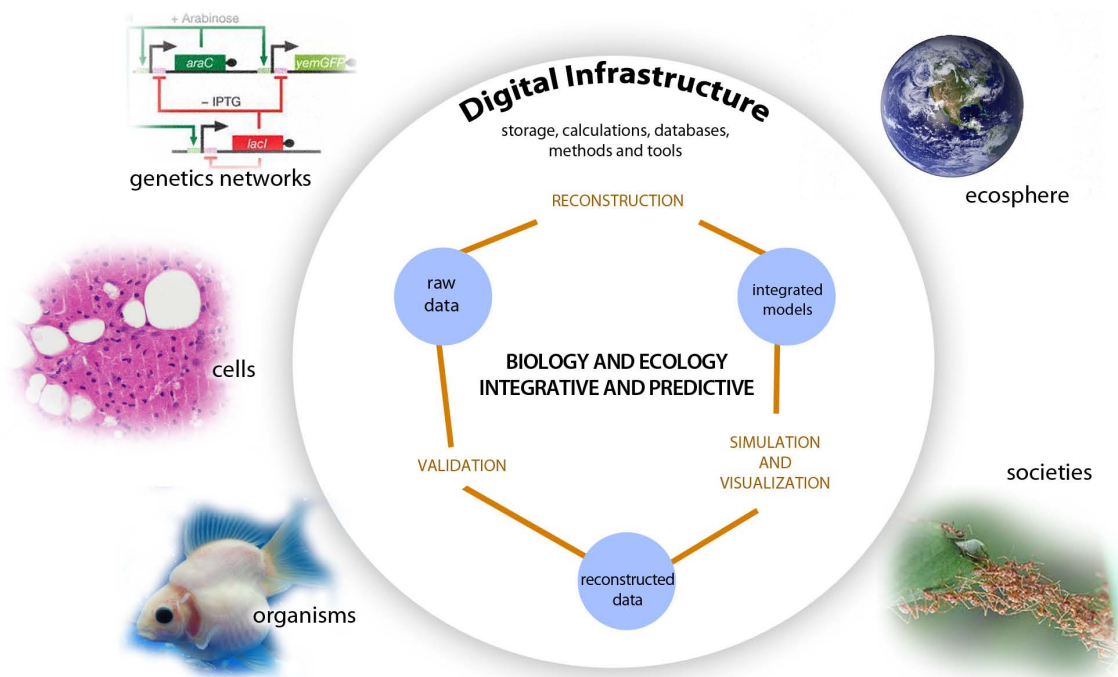*This infrastructure will be the link to:*

- *Share*
- *Collect*
- *Treat*
- *Validate*
- *Store*

large quantities of data obtained through multiscale examination

The expected results will be the reconstruction of integrated models

The task is not so much to see what nobody has seen yet, but to think what no one has thought as yet about that which everybody can see.

Arthur Schopenhauer

FROM THE MOLECULE TO THE ECOSPHERE

genetics networks

cells

organisms

Digital Infrastructure
storage, calculations, databases, methods and tools

RECONSTRUCTION

raw data

integrated models

BIOLOGY AND ECOLOGY INTEGRATIVE AND PREDICTIVE

SIMULATION AND VISUALIZATION

VALIDATION

reconstructed data

ecosphere

societies

COMPLEX SYSTEMS: THINK DIFFERENTLY

TOWARDS INTEGRATED MULTISCALE MODELS

Reconstruction of integrated models from cohorts of multiscale data.

To have detailed but patchy knowledge of complex systems which surround us is a scenario that can no longer be accepted. Understanding complex systems implies modelling them. Models should provide a reconstruction of the data obtained from the observation of those systems.

The process of reconstruction activity is by its nature interdisciplinary , and it is done by teams of experts from formal disciplines, mathematics, informatics, and physics being.

Integrated models combine multiscale observation in a predictive way. With complex systems, prediction is not the certainty of what will occur, but is the probability of what can occur. Such predicts enable the construction of strategies which are robust or even, in the case of severe disruptions, resilient .

The future generations worldwide need the engineering of complex systems.

ESTABLISH THE SCIENCE OF COMPLEX SYSTEMS

Without an integrated model, what can happen cannot be foreseen and according to **Paul Valéry`s** *phrase,there is a high risk «to go backwards into the future».*

FROM NEUROTRANSMITTER TO THE WEB
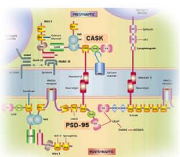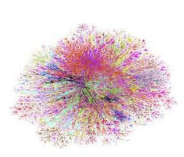
Molecura network	Neuron network	Brain network	Social network	WWW network

A platform with the necessary means :

To make models of the learning brain to integrate results ar various scales in a unified view

To experiment in order to understand how brains can learn at different ages of life

To innovate for the school of future : Personalised instrument panel which marks out the roads to the world

COMPLEX SYSTEMS: THINK DIFFERENTLY

TOWARDS THE ENGINEERING OF COMPLEX SYSTEMS

The science and engineering of complex systems will become more and more intertwined in order to integrate the data and the models aimed at predicting and preventing.

In order to research and teach the dynamics of complex systems, it is necessary to have a close coordination between scientists and those who wish to participate in the collection of in vivo, in toto, and in situ multiscale data. In the age of ubiquitous information and communication, such data collection is but an extension of Internet to sensors of all kinds, when, for example, one must watch over young children, over the elderly, or over nature.

Having increasing number of integrated models at one's disposal will enable the simulation of the consequences of perturbation and the prevention of internal or external disruptions, including resilient strategies in advance of extreme events.

THE ENGINEERING OF COMPLEX SYSTEMS IS A MULTIDISCIPLINARY APPROACH WHICH AIMS AT ANSWERING THE QUESTION OF A CREATIVE,VIABLE, AND SUSTAINABLE WORLD

FROM MODELISATION
TO RESPONSIBLE INNOVATION

An idea which is right must agree with the object that it represents.

Espinoza

COMPLEX SYSTEMS MODELISATION

RESPONSIBLE INNOVATION

Personalised health
Drug design
Effect prediction
Epidemics

Personalised education
Knowledge integration
Ubiquitous learning

Transports
Security
Adaptation to resources

Green biotechnology
Sustainable growth

Social intelligence
Control the web

Responsible technologies
Toxicology (nano, REACH)
Man and the planet in the loop

COMPLEX SYSTEMS : THINK DIFFERENTLY