

UNITWIN UNESCO

**DIGITAL CAMPUS
OF COMPLEX SYSTEMS**



Complex Systems Society

CSS

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.*

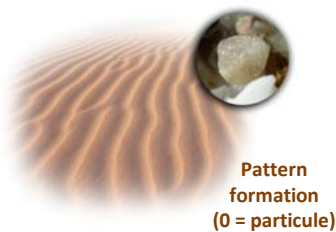
TO STUDY COMPLEX SYSTEMS :
THE COMPLEX SYSTEMS DIGITAL
CAMPUS WITH ITS:

- Digital University
- Digital Institute

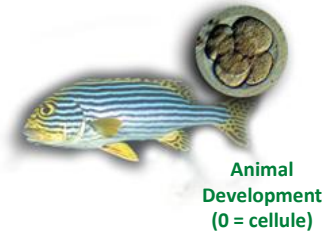
PHYSICAL, BIOLOGICAL, TECHNO-SOCIAUX SYSTEMS

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 -



Pattern formation
(0 = particule)



Animal Development
(0 = cellule)



Insect colonies
(0 = ant)



Brain and cognition
(0 = neurone)



Social networks
(0 = individu)



Internet & Web
(0 = host / page)

THE COMPLEX SYSTEMS DIGITAL UNIVERSITY

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 cursus.

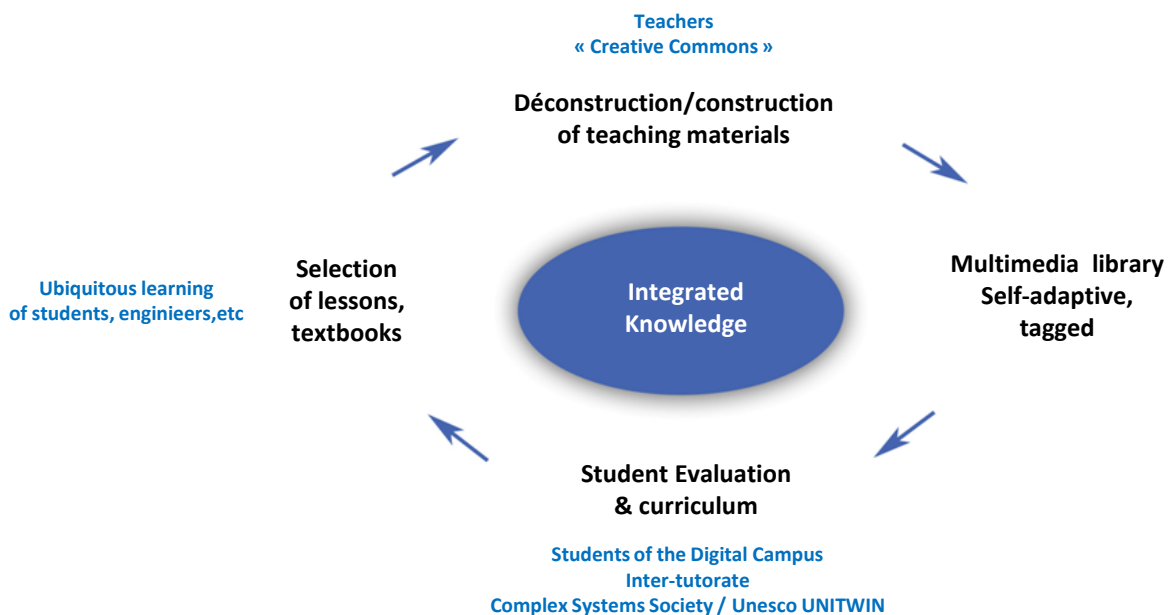
It will provide:
multimedia library of teaching materials supplied by teachers, researchers and students autoadapted to the needs of individuals and groups: its content will develop in proportion to the number of research projects of the various users.

- *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

TOWARDS A PERSONALISED EDUCATION

*Tell me and I forget,
Teach me and I remember,
Involve me and I learn.*
- Benjamin Franklin -



THE 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



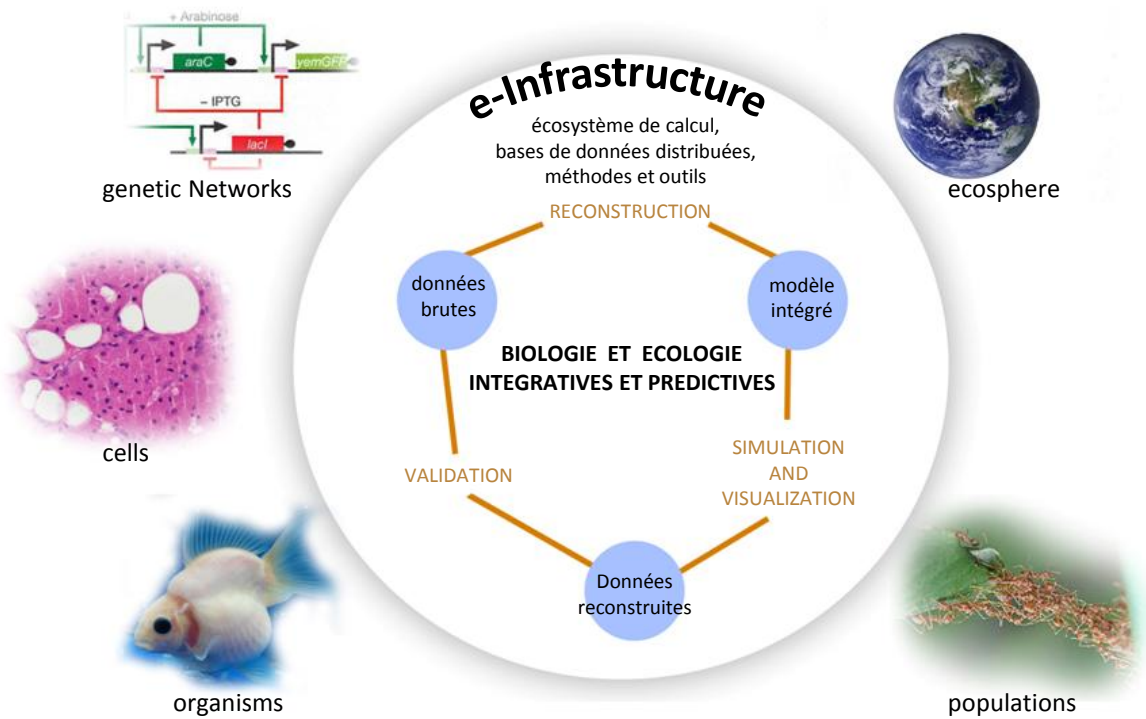
large quantities of data obtained through multiscale examination

The expected results will be the reconstruction of integrated models

FROM THE ORGANISM TO THE ECOSPHERE

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 -



TOWARDS INTEGRATED MULTISCALE MODELS

Reconstruction of integrated models from cohorts of multiscale data

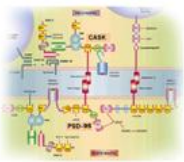
*To have detailed but patchy knowledge of complex systems which surround us is a scenario that can no longer be accepted. Understanding complex systems implies modelling them. Models should provide a reconstruction of the data obtained from the observation of those systems. The process of reconstruction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

From the neurotransmitter to the web

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».

Molecular Network



Neuronal Network



Brain Network



Social Network



Réseau WWW



A educational ecosystem for:

Modelling the learning brain to integrate results at various scale in an unified view

Experimenting in order to Understand how brains can learn at different ages of life

Innovating for the school of the future: personalized instrument panel which marks out the roads to the world

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 MODELLING TO RESPONSIBLE INNOVATION

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

