First International Symposium of UNESCO Chairs in Anticipatory Systems, Futures Studies and Futures Literacy

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Department of Sociology and Social Research

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A MATHEMATICAL MODEL

FOR ANTICIPATION AND FUTURES LITERACY

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THE ROLE OF ANTICIPATION

Anticipation is a more or less developed property of adaptive systems, such as biological and social systems. In Rosen's anticipatory systems, it results from the existence of an internal predictive model of the structure of the system.
Here we consider the role of anticipation in the evolution of open multi-level systems with some conscious agents such as human societies. The problem is to find the characteristics allowing them: (i) to enhance their comprehension of the nature and role of anticipation; (ii) to use this knowledge to search for possible procedures and virtually evaluate their impact on behaviour, decision-making and/or future action.

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THE FUTURES LITERACY (FL) FRAMEWORK

"FL is an emergent and evolving capability <… > to identify, design, target and deploy *Anticipatory Assumptions* (AA). <…> to 'use-the-future' for specific ends in particular contexts.".
(Miller in "*Transforming the Future*",2018).

The FL framework searches means to develop FL for an individual or a society. For that, it proposes the formation of *FL-Labor-atories (FLL).*where a group of people cooperate to solve some specific problems. Initially each participant has its own more or less tacit stock of knowledge and interpretations. By a 3-steps design process, these personal stocks are mixed through communications, generating new shared knowledge flows; these allow finding new AA at the root of innovative solutions.

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FINDING A MATHEMATICAL MODEL FOR fLL

The concept of a FLL and its 3-steps design process have been experimentally conceived, and the *collective intelligence knowledge creation* (CIKC) process which happens in it experimentally ascertained.
Can we find a mathematical model which, formalizing what happens in a FLL in general or in specific implementations, helps enhancing the effectiveness of CIKC in FLL customized for particular research goals and laboratory contexts?

We are going to give such a model using the MES methodology, (Ehresmann and Vanbremeersch, 1987-2007) which is based on a 'dynamic' category theory integrating time.

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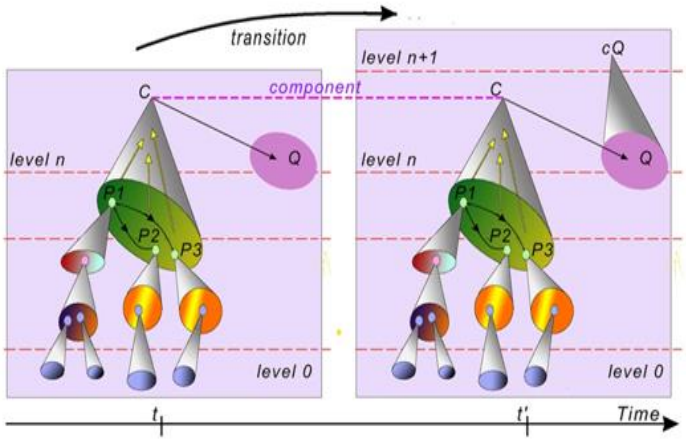
MEMORY EVOLUTIVE SYSTEMS (MES)

MES give an integrative study of complex evolutionary 'living' systems which are impredicative on the long term, such as biological or social cognitive systems. They have:

(i) a *hierarchy* of interacting components varying in time,
(ii) a self-organisation by a network of *co-regulator* agents,
(iii) a multi-level flexible *memory* developing in time.



Formally a MES is a family of hierarchical categories, indexed by time, connected by partial functors 'transition'. These transitions ase generated by De/Complexification Processes consisting in addition, suppression or combination of components.

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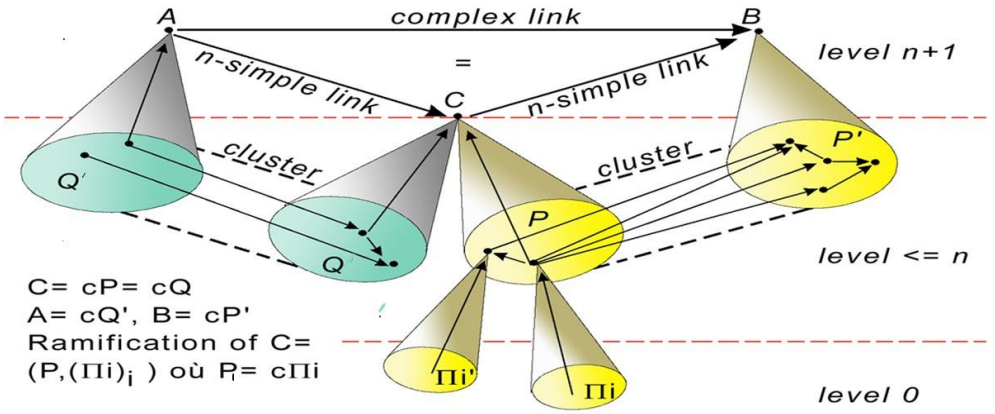
MP AT THE BASIS OF EMERGENCE IN MES

A main property of MES is the ***Multiplicity Principle*** (MP). it is a kind of flexible redundancy (called 'degeneracy ' in Biology) which assumes the existence of *multifaceted* components C .
The ***Emergence Theorem*** shows that MP is the property which, through successive De/Complexification Processes, allows for the emergence over time of multifaceted components of increasing complexity order and of *complex links* between them; such links model "changes in the conditions of change" (Popper).



THE ARCHETYPAL CORE OF A FL-MES

We define a *FL-MES* as the MES modeling a society S which has for co-regulator O the group of participants to a FLL. As a consequence of the Emergence Theorem, this FL-MES develops a flexible memory admitting a higher level subsystem, called its *Archetypal Core* AC

This AC consists of strongly connected higher order multiifaceted records integrating multiple modalities. It acts as an internal model of the system reflecting its complex identity and as a motor for the evolution of the system.

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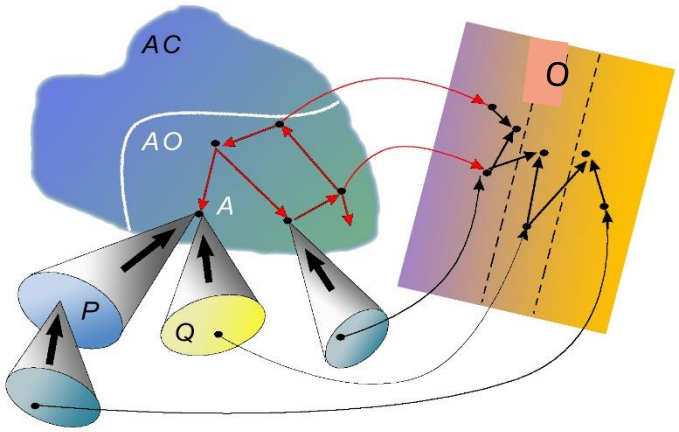
THE FLL OPERATION

In the FL-MES, the participants to O develop, through communication exchanges, a common pattern AO in **AC**, consisting of shared records . They use it to construct a collective landscape LO in which they can operate: (i) a *retrospection* process ("scanning the horizon") and (ii) a *prospection* process to find and virtually evaluate new AA, eventually leading to more innovative futures.



In O the black arrows represent interactions between its members. The long curved arrows are the components of LO.

HUMAN-MACHINE EXTENSION OF THE FLF

FL can be extended to the case of a *social organisation* S in which a group G of people customizes an evolutive high-tech *Data-Analyzer* DA (with receptors, effectors, processing unit and multi-level memory) for developing rich human-machine interactions.

The aim is that together G et DA form a (mixed) FLL in which they develop collective intelligence knowledge creation processes and become Futures Literate. In this way, they act as an efficient *decision-maker*, capable to design both ***'repetition'*** AA ("colonising" the future), and '**innovative'** AA (for 'novel' futures). The presence of DA also allows faster responses to emergencies, with applications to risk-prevention, e.g. in the domain of health.

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CONCLUSION

The FL-MES model allows to formalize the processes which develop in a FL-Laboratory. It should help to develop specialized FLL for solving particular problems in different settings. And it extends in the case of mixed human-machine interactions

For more details on the presented results, we refer to:

1. The book "*Transforming the Future*" (ed. R. Miller), 2018) ; in particular this presentation can be seen as a summary of Chapter 3.
2. On MES, the book "*Memory Evolutive Systems*", Ehresmann & Vanbremeersch, Elsevier 2007.
3. A number of recent articles on my site
   https://ehres.pagesperso-orange.fr

THANKS FOR YOUR ATTENTION