



SEMINAR SERIES / TRINITY 2009

Convenors: Felix Reed-Tsochas, *Institute for Science, Innovation and Society, Saïd Business School*
Eduardo López, *Saïd Business School*

Tuesday 26th May

12.30 – 2.00pm

Seminar Room B, Saïd Business School

Prof. Geoffrey West

Santa Fe Institute

“Size Matters: Growth, Innovation, Economies of Scale and the Pace of Life from Cells to Cities and Corporations”

ABSTRACT

Although Life is very likely the most complex phenomenon in the Universe, many of its most fundamental and complex phenomena scale with size in a surprisingly simple fashion. For example, metabolic rate scales approximately as the $3/4$ -power of mass over 27 orders of magnitude from complex molecules up to the largest multicellular organisms. Similarly, time-scales (such as lifespans and growth-rates) and sizes (such as genome lengths, RNA densities, and tree heights) scale as power laws with exponents which are typically simple multiples of $1/4$. The universality and simplicity of these relationships, together with emergent "universal" invariants, suggest that fundamental constraints underlie much of the coarse-grained generic structure and organisation of living systems. It will be shown how these $1/4$ power scaling laws follow from underlying principles embedded in the dynamical and geometrical structure of space-filling, fractal-like, hierarchical branching networks, presumed optimised by natural selection. These ideas lead to a general quantitative, predictive theory that potentially captures the essential features of many diverse biological systems. Examples will include vascular systems, growth, cancer, aging and mortality, sleep, cell size, genome lengths, and DNA nucleotide substitution rates. These ideas will be extended to social organisations: to what extent are cities or corporations an extension of biology? Are they "just" very large organisms? Analogous scaling laws reflecting underlying social network structure point to general principles of organization common to all cities, but, counter to biological systems, the pace of social life systematically increases with size. This has dramatic implications for growth, development and particularly for sustainability: innovation and wealth creation that fuel social systems, if left unchecked, potentially sow the seeds for their inevitable collapse.

Our meetings intend to provide a forum for rigorous research (in a broad range of disciplines) focusing on complex adaptive systems, using methods and techniques such as agent-based modelling and complex network analysis. Since potential areas of application for such approaches can be located across the social, natural and engineering sciences, our aim is to involve participants from a wide range of departments in Oxford. We welcome talks which focus on particular areas of application and associated technical issues, but also encourage contributions which address more fundamental conceptual or mathematical problems. The CABDyN Seminar Series is one of the activities of the CABDyN Research Cluster (<http://sbs-xnet.sbs.ox.ac.uk/complexity/>).

Sandwiches and drinks will be provided

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