

Using system dynamics modelling and policy simulation to find solutions to environmental problems through increased understanding of complex dynamic systems

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Complex dynamic systems are characterised by non-linear coupling of variables and inherent time delays and, as such, cannot be properly comprehended by the unaided human mind. 'System dynamics' is the title given to the study of the theory of complex dynamic systems, the functioning of such systems, and the subsequent generation of decision support tools.

Simulation modelling, in the system dynamics tradition, has now developed into a profession and represents a growth area in management science where computer models are used in the formulation and evaluation of policies in governance, business and educational settings.

Contemporary computing allows the use of simulation software to trace the behavioural implications of complex interrelationships. Through the generation of quantitative mathematical models, model builders are forced to make explicit their assumptions relating to a specific problem. In the process of building the model they have an opportunity to resolve any contradictions or ambiguities and, in so doing, greatly improve their mental models of the problem in question. On completion, policy makers have at their disposal a tool for testing the relative merits of various policy alternatives. Computer simulation models collapse time, capture non-linear relationships, and expose complex interdependencies. Simulation modelling is a powerful tool for the formulation and evaluation of policies.

Simulation models are generally agreed to be particularly suited to one class of system, the complex dynamic system.

All socio-economic-environmental systems may be regarded as complex dynamic systems, and managing the environmental consequences of economic growth and social change requires an understanding of these systems. It is now generally recognised that environmental problems cannot be solved in isolation from their social and economic contexts. In order to help find solutions for environmental and health problems, researchers at the University of Limerick Centre for Environmental Research have worked on modelling mineral extraction, spread of disease and the sustainability of urban settlements. Our work involves building models using commercial software packages, and has resulted in approximately 20 publications to date. The paper will provide details on selected examples.