Jeroen van den Bergh

Efficiency-Diversity Trade-offs in Transitions

The transition to sustainable development involves innovation or diversity creation. The objectives of efficiency and diversity are often posed as conflicting with one another. This, however, neglects the benefits of diversity, in terms of not only keeping options open but also realizing system improvements through innovation. Traditional economic approaches to analyze optimal diversity, such as option value and real options theories describe the benefits of diversity in an exogenous manner. In this paper a simple evolutionary model is developed to assess the impact of diversity on system dynamics. This involves treating diversity as an endogenous variable which is associated with economic value. It is analyzed how an optimal balance between diversity and short term efficiency can be achieved, from which implications for policy guidance are derived.

Koen Frenken

A complex systems methodology to transition management

There is a general sense of urgency that major technological transitions are required for sustainable development. Yet, top-down steering of such transitions towards some pre-specified desired end state is difficult, if not impossible. Instead, transitions are best perceived as involving multiple transition steps. Due to path dependence, an initial transition step that is motivated by the wish to end up in a particular preferred system, may cut off other possible development trajectories, which later may turn out to be more desirable. For this reason, initial transition steps should allow for future flexibility, where we define flexibility as robustness regarding changing evidence and changing preferences. We propose a technology assessment methodology that identifies the flexibility of initial transition steps from a complex systems perspective. Using the NK-model of rugged fitness landscapes, we can identify multiple local optima and characterize the flexibility of the routes towards these optima. We illustrate our methodology by an empirical application to possible future car systems.

Jürgen Klüver

Geometrical Conditions of Social Dynamics: Multi Level Models and Empirical Confirmations

A "social geometry" may be defined as the set of rules of interaction that determine which social actor will (or may) interact with which other actors. In am mathematical way a social geometry can be represented as a directed and often also weighted graph; the "geometrical" rules are accordingly represented in an enlarged adjacency matrix. "Enlarged" means that akin to the weight matrices of neural networks the social relations form a matrix with values from –1 to +1.

Several theoretical and empirical investigations of our research group show that the social geometry is the most important factor for the generation of specific social dynamics. This insight is valid not only for the dynamics of social groups but also for the cognitive dynamics of individual actors and the evolutionary dynamics of whole societies. In the second part of my lecture I shall give several examples of the impact of social and cognitive geometry on the dynamics of the respective systems.

The methodical approach for our investigations is the representation of social phenomena by formal complex dynamical systems. This means that we take social actors, i.e. occupants of certain social roles, as the basic level of a complex system, analyze the specific rules of social interaction and initial states respectively and investigate the dynamics generated by the rules in computer models. This is done by the application of so called "Soft Computing Models", namely cellular automata, Boolean nets, neural networks and evolutionary algorithms. If one takes into account that social actors frequently cannot just be represented as finite state automata a second level is introduced in the model, namely the modelling of the individual actors themselves as complex dynamical systems. For example, if one uses as basic level the representation of a social group via a cellular automaton (actors as cells) then the actors may be represented by

neural networks. In this way it is possible to analyze the influence of cognitive processes of the actors on the social interactions. In addition, if one wants to model the aggregation of the single actors to "collective actors" like political parties, firms or whole nations a third level is introduced with the collective actors as components. Such a multi level model, which is a universal modelling schema, allows the analysis of complex interdependencies between the different levels.

On the basis of these theoretical and methodical considerations it is possible to model social and cognitive processes as thoroughly as the respective problem demands. I shall show examples of the prediction of the behaviour of social groups, the prediction of the outcome of communicative processes, the formal representation and explanation of individual socialization processes, and last but not least the explanation of the socio-cultural evolution of whole societies via the model of a socio-cultural-cognitive algorithm. To put it into a nutshell, a mathematical or computational respectively social science is a very concrete possibility.

Flaminio Squazzoni

Theoretical and Methodological Issues on Societal Transitions: A Social Simulation Viewpoint

Sociology covers a good number of examples of theoretical models on transitions. All of these are theoretical and descriptive accounts of societal transitions (e.g. Simmel [1900] on money, Weber [1904] on capitalism, Elias [1939] on civilisation process, Wallerstein [1974] on modern-world system, Chandler [1977] on the second industrial revolution, Castells [1996] on the rise of the information society), with little attention to the need of formalising models and theories. As a consequence, they are big picture accounts, with very rich descriptions, historical depth and suggestive intuitions, which should be taken as landmarks, but which are often impossible to verify in scientific terms. The talk argues that computer simulation as a method, and agent-based models (ABMs) as tools, is a possible mean for adding theoretical and empirical value to social transition models. They can allow zipping a rich theory in a model and carefully verifying resultant or emergent consequences.

The talk describes features and results of ABMs for the understanding of social phenomena, in order to get out some lessons to be discussed with scholars on societal transitions. Among the technical and methodological features of ABMs, a particular attention is given to these follows: the criterion of ontological correspondence, the micro plausibility (heterogeneity, autonomy, bounded and adaptive rationality), the understanding of the effect of complex and dynamic interaction structures, the presence of geo-physical/social interdependence environment, and the possibility of producing a generative causal theory of the phenomenon to be explained. Among the lessons that we can get out of the results of ABMs application to the understanding of the social phenomena, there are at least four: 1) don't forget the role of cognitive nature of human/social agents; 2) don't underestimate the effect of social influence on individual behaviour; 3) don't reduce the quest of the impact of macro social level just to causal effect of formal institutions (incentives, agreements, authority, contracts), but take carefully into account the role of informal institutions and of socially shared models of interpretation and action's contextualisation, 4) finally, don't overload too much the model with systemic properties, levels, macro-interactions, while under-representing agents and their cognitive aspects.
As a conclusion, the talk stresses the importance of fostering a positive collaboration between scholars working in social simulation and scholars working on societal transitions, given the firm belief that these topics are of paramount importance not only for analytical purposes, but also for social transition management.

Tanya Araújo

Market-oriented innovation: When is it profitable? An abstract agent-based study

Transitions from the innovation perspective…