THEMES'09 - Integrated analysis of complex, adaptive systems

Mon 15 June, 11-12:30
Complexity - What Drives and is Driven by Evolution!
By Peter M Allen, University of Cranfield
http://www.som.cranfield.ac.uk/som/p2054/People/Faculty/Academic-Faculty-Listing-A-Z/Peter-Allen
In this talk the origins of Complex Systems thinking will be presented together with its relevance to ecology, social and economic systems. The difference between system dynamics, probabilistic system dynamics and evolutionary modeling will also be explained. Then several examples will be used to illustrate the ideas.
Reading (core): (Allen 1998) Google Books link http://books.google.co.uk/books?hl=en&lr=&id=14PtBm6cFLgC&oi=fnd&pg=PA3&dq=peter+allen+complexity&ots=4fpAfhaaKb&sig=7RBEM5jUbfEg2KEZIe9mQ8TOyTw
(Allen, et al. 2006)

Tue 16 June, 9 – 10:30
Embracing Complexity: Applying the Ideas
By Peter M Allen, University of Cranfield
http://www.som.cranfield.ac.uk/som/p2054/People/Faculty/Academic-Faculty-Listing-A-Z/Peter-Allen
We shall present models of market systems, organizations and supply chains as evolutionary complex systems. Such systems are really about the participant agents learning by doing, and the overall picture one of a generalized "creative destruction". These models will be described and the implications and utility discussed. In the end we shall show the importance of understanding the limits to knowledge and of dealing with it through the permanent evolution of our interpretive frameworks. In practical terms then adaptive and learning behaviour requires the development of complex systems models to capture current beliefs and signal both a change in the environment and new paths of exploration.

Tue 16 June, 11 – 12:30
Diversity in Complex Socio-technical Systems: rationales, implications and a framework for analysis
By Andy Stirling, SPRU – University of Sussex
http://www.sussex.ac.uk/spru/profile7513.html
This session will explore a framework for more integrated general analysis of diversity in complex socio-technical systems. A review of key policy issues will indicate a range of significant qualities attributed to social and technological diversity. These are accompanied by a series of well documented challenges. Drawing especially on policy discourses around energy diversity, the session will outline a framework recognizing three necessary but individually insufficient properties of diversity. Based on 10 quality criteria, it will explain a general quantitative non-parametric diversity heuristic. This allows the systematic exploration of diversity under inevitably contrasting policy perspectives on complex socio-technical system, including divergent conceptions of relevant attributes and contrasting weightings on different diversity properties. It will be shown how this heuristic may be used in practice to explore different possible trade-offs between diversity and other aspects of interest, including portfolio interactions. The argument will be made that the resulting approach offers a way to be more systematic and transparent in the treatment of social, economic and technological diversity in a range of fields, including research governance, technology policy and sustainable innovation.
Reading (core): (Stirling 2009, forthcoming)
Reading (recommended): (Page 2007) http://press.princeton.edu/chapters/s8353.pdf

Tue 16 June, 14 – 15:30
Technological Innovation and Complexity Theory
By Koen Frenken, University of Utrecht / Eindhoven Technical University

http://econ.geo.uu.nl/frenken/frenken.html
In this lecture I will explain three core models from complexity theory in the realm of technological innovation (percolation, NK, complex networks). In this review, I will explain how these models can explain some of the important features of technological innovation, which have been addressed before in evolutionary economics. As such, complexity theory provides a welcome theoretical contribution strengtening the theoretical basis of evolutionary economics and opening new theoretical and empirical research avenues. I will also go into the methodological issues concerning the use of complexity models and their relation to agent-based modelling.
Readings (core): (Frenken 2006)
Readings (additional): (Boschetti and Brede 2009; Cantono and Silverberg 2009; Schwoon, et al. 2008)

Wed 17 Jun, 9-10:30
Methods for analysing complex systems – Agent-based modelling
By Sigrid Stagl, SPRU – University of Sussex
http://www.sussex.ac.uk/spru/profile185233.html
Agent-based modeling is a simulation modeling technique that is increasingly used in natural and social sciences. It is particularly suitable for analysing complex systems with heterogeneous agents and for exploring emergent properties. This session will introduce the modeling technique and show several examples.
Readings: (Bonabeau 2002; Kaufmann, et al. forthcoming)

Wed 17 Jun, 10-12:30
Evolutionary Models of Technological Transitions
By Koen Frenken, University of Utrecht / Eindhoven Technical University
http://econ.geo.uu.nl/frenken/frenken.html
In this lecture, I will discuss the insights that evolutionary economics has provided in the analysis of technological transitions. The main message of evolutionary models holds that positive externalities associated with the adoption of an incumbent technology hampers the transition towards a new technology. The main goal of various theoretical models has then been to understand under what (policy) conditions a transition between two technologies, or technological paradigms, can take place. I end the lecture with a recent model using directed graphs as a way to model technology evolution.
Readings (core): (Arthur 1989; Bruckner, et al. 1996)
Readings (additional): (Bikhchandani, et al. 1992; Faber and Frenken 2009; Frenken and Izquierdo 2009; Weisbuch, et al. 2008; Windrum, et al. 2009a; Windrum, et al. 2009b)

Wed 17 Jun, 14-15:30
Evolutionary theories of socio-economic change: building blocks, achievements and challenges ahead
By Giovanni Dosi, LEM - Sant'Anna School of Advanced Studies, Pisa
http://www.lem.sssup.it/cv/Dosi_CV.pdf
I shall sketch out the main results achieved by different approaches that invoke evolutionary explanations of economic phenomea and map overlaps and differences among them. More specifically, I shall concisely outline (a) models and empirical studies broadly in a post-Schumpeterian perspective of the genre often ascribed to Nelson and Winter (1982); (b) evolutionary game theories; (c) organizational ecology approaches; (d) artificial economies and (e) part of the expanding literature on adaptive learning which is based on some evolutionary argument.
Readings: (Dosi and Winter) and ch 1-5 of (Nelson and Winter 1982)

Thu 18 Jun, 9-10:30
Approaching Evolutionary Economics
By Ed Steinmueller, SPRU – University of Sussex

http://www.sussex.ac.uk/spru/profile26086.html
This lecture will focus on the roles that evolutionary economics has played in challenging the dominant paradigm of modern economics – both from a historical (20th century) and contemporary perspective. The foundational objectives are to define some of the key aims that have been pursued, the motivations for pursuing these aims, and the research programmes that have resulted. The aspiration of this lecture is to provide some understanding of why evolutionary economics has yet to succeed in creating a 'scientific revolution' in a Kuhnian sense and, by extension, the challenges of other types of transitions including those related to our relation to the environment.
Reading: (Andersen 1996) Copy without full references is downloadable from http://www.business.aau.dk/evolution/projects/eebook/
Note errata: Pages 7 and 8 includes three errors in the tatonnement algorithms! In both the naive and the smarter tatonnement, the summations should be over the i's (the individuals) and not the j's (the commodities). In the smarter tatonnement algorithm, there should be a numerical sign around the D(P) in the condition. Finally, there should be both a plus and a minus before the changing of the price in smarter tatonnement (indicating that different actions are taken in the cases of positive and negative aggregate excess demand). – Andersen's web site http://www.business.aau.dk/evolution/esa/ also contains many other papers on evolutionary and Schumpeterian economics

Thu 18 Jun, 11-12:30
The Boundaries between Evolutionary and Institutional Economics
By Ed Steinmueller, SPRU – University of Sussex
http://www.sussex.ac.uk/spru/profile26086.html
This lecture considers the relation between old and new institutional economic as it intertwines with issues of issues of evolutionary economics. Of particular interest in this lecture are topics such as governance, communities and networks of practice, filiere or 'value chains,' and collective action more generally. The perspectives of the French regulation school of thought as well as more recent concerns for self-organising and emergent behaviours are considered. The aspiration of this lecture is to provide some insights into the ways in which institutions in the sociological sense (rules, norms, and standards) evolve over time and as the result of experience.
Reading: (Coriat and Dosi 1995) http://esnie.u-paris10.fr/pdf/textes_2007/Dosi-chap-12.pdf

Thu 18 Jun, 14-15:30
Schumpeter Meeting Keynes: A Policy-Friendly Model of Endogenous Growth and Business Cycles
By Giovanni Dosi, LEM - Sant'Anna School of Advanced Studies, Pisa
http://www.lem.sssup.it/cv/Dosi_CV.pdf
I shall present an agent-based model that bridges Keynesian theories of demand generation and Schumpeterian theories of technology-fueled economic growth. The model is employed to investigate the properties of macroeconomic dynamics and the impact of public policies on supply, demand and the "fundamentals" of the economy. In the related paper, we find that the complementarities between factors influencing aggregate demand and drivers of technological change reflect both "short-run" fluctuations and long-term growth patterns. From a normative point of view, simulations show a corresponding complementarity between Keynesian and Schumpeterian policies in sustaining long-run growth paths characterized by mild fluctuations and acceptable unemployment levels. The matching or mismatching between innovative exploration of new technologies and the conditions of demand generation appear to suggest the presence of two distinct "regimes" of growth (or absence thereof) characterized by different short-run fluctuations and unemployment levels.
Readings: (Dosi, et al. 2008)

Fri June 19, 9-10:30

Beyond Weak and Strong Sustainability: An Evolutionary Approach
By John Gowdy, Dpt of Economics, Rensselaer Polytechnic Institute, Troy, NY
http://www.rpi.edu/~gowdyj/
This lecture will survey "sustainability" (weak, strong, and ecological). Two major points are (1) the inability of the standard welfare model to account for qualitative change, and (2) the convergence of the policy recommendations of neoclassical and ecological economists concerning sustainability. The case of the Pacific island nation of Nauru will illustrate the conflict between market economies and the environment, and the danger of transforming the natural world into financial capital.
Readings: (Gowdy and Juliá 2009, forthcoming; Gowdy and Krall 2009, forthcoming; Gowdy and McDaniel 2008)

Fri June 19, 11-12:30
Policy Learning and Evolutions in Environmental Policy & Governance
By Andy Gouldson, School of Earth and Environment, University of Leeds
http://www.see.leeds.ac.uk/people/a.gouldson
Environmental policies have evolved rapidly in recent years, with new institutions and new instruments emerging in many contexts in response to new political agendas and also the wider recognition of new environmental pressures. At the same time, globalisation and liberalisation have led to a more widespread acknowledgement of the weaknesses of the state. This in turn has led to increased interest in new modes of environmental governance that rely not only on the state but also on civic and market actors. Although it is accepted that this tends to lead to decentred (i.e. multi-level, multi-actor) processes, these new forms of governance (if indeed they are new) remain poorly understood. This session will explore the processes of policy learning associated with these changes, and it will critically evaluate the nature and influence of new forms of environmental policy and governance.
Reading: (Paavola, et al. 2009)

Fri June 19, 11-12:30
The Emergence of better Environmental Regulation
By Andy Gouldson, School of Earth and Environment, University of Leeds
http://www.see.leeds.ac.uk/people/a.gouldson
Governments in many contexts are under pressure to find better (i.e. more effective, efficient, equitable, politically and administratively viable) ways of achieving environmental objectives. Although regulation has long been criticised for performing badly against all of these criteria, regulation remains a key policy instrument in many contexts. As a result, the better regulation agenda has become significant in the OECD, the EU and the UK. This session will explore the key features of this agenda - focusing particularly on evolutions in regulatory practice within the Environment Agency for England and Wales. Focusing on the micro-level interactions between regulators, firms and stakeholders, it will examine the pros and cons of risk-based approaches to regulation where regulators move away from a `one size fits all' approach towards one which targets the higher risks and the worse performers. In so doing it will examine forthcoming innovations in environmental policy that link to broader debates on environmental governance.
Reading: (Gouldson 2004; Gouldson, et al. 2009)

Sat June 20, 9-10:30
Institutions for Sustainable Development
By Arild Vatn, UMB – Norwegian University of Life Sciences
http://www.umb.no/noragric/ansatte/arild.vatn
The focus of this lecture will be twofold. First I will engage in a description of to-days core economic and political institutions and their ability to secure sustainable development. A set of problems with relevance to sustainability will be identified. In the second part I will discuss options for institutional changes to better

handle these problems. The core argument of the lecture is that we have constructed a system based on separated choices and responsibilities, while the problems we face demand integrated decision making. Human action is interdependent not least through the various dynamics of natural systems. These interdependencies can be divided into specific and generalized interdependencies. The present system is best at tackling specific interdependencies, while it is generalized interdependencies that dominate to-days activities. The resilience of natural system protects them and us against potential consequences of our actions. To the extent that the resilience model offers a good description of living systems, we face, however, some daunting challenges. Our institutional systems are not well adapted to the dynamics of resilient systems. While resilience offers time to change development paths that are detrimental in the longer run, our institutions are rather pushing the system closer to the various 'tipping points' as resilience is 'hiding' for us the future consequences of our actions. Finding solutions to this problem is both urgent and demanding.
Readings (core): (Folke 2006)
Readings (additional): (Richerson, et al. 2002; Vatn 2009a; Vatn 2009b)

Sat June 20, 11-12:30
Behavioural Economics and Climate Change Policy
By John Gowdy, Dpt of Economics, Rensselaer Polytechnic Institute, Troy, NY
http://www.rpi.edu/~gowdyj/
This lecture will present some basic facts about climate change and the human perturbation of the global carbon cycle. The debate surrounding the Stern Review will be discussed, focusing on the discounting issue. The "Ramsey equation" will be used to illustrate the ethical, the economic, and the biophysical aspects of climate change policy. Findings from behavioral economic research relevant to climate change policy will be discussed, including some original research by the lecturer.
Reading: (Gilbert 2006; Gowdy 2008; Leiserowitz 2007/2008)

Mon 22 Jun, 9:00-10:30
Sustainable Behaviours
By Sigrid Stagl, SPRU – University of Sussex
http://www.sussex.ac.uk/spru/profile185233.html
'Sustainability does not come naturally' to the human species. If it did 'come naturally', we could argue with Rousseau that humans are 'naturally good and only by institutions… made bad' and then focus all our efforts on devising appropriate policies and measures. As it is, the concept of 'sustainable behaviour' suggests the need for a much deeper engagement with both 'human nature' and social structure, and an understanding of the relationship between these two, before proceeding to policy prescription. This lecture reviews theories and empirical evidence from institutional economics, experimental economics, social psychology, sociology and neuroscience that improve our understanding of the relationship between actor characteristics, social institutions, decisions and pro-environmental behaviours.
Reading: (Darnton, et al. 2006; Dawkins 2001; Jackson, et al. 2004)

Mon 22 Jun, 11-12:30
Strategies for sustainable development – a group exercise
By Arild Vatn, UMB – Norwegian University of Life Sciences
http://www.umb.no/noragric/ansatte/arild.vatn
In this exercise students will be asked to involve in group discussions over the experiences learned so far in the course section on sustainability. Dependent on the discussions and issues raised during the Sustainability Session, a set of topics for group discussions will be formulated

Mon 22 Jun, 14-15:30

The dynamics of socio-technical transitions: The multi-level perspective and a case study
By Frank Geels, SPRU – University of Sussex
http://www.sussex.ac.uk/spru/profile228052.html
Socio-technical transitions address shifts at the level of societal functions (transport, energy, healthcare, agri-food, entertainment etc). These functions are fulfilled by socio-technical systems, i.e. clusters of elements such as technology, markets, regulations, infrastructure, industries, science and symbolic/cultural meaning. Transitions are shifts from one socio-technical system to another. They have the following characteristics: a) co-evolutionary processes, b) multi-actor processes interactions (e.g. firms, consumers, policy makers, social movements, researchers), c) long-term processes (40-50 years). Socio-technical transitions currently receive much policy attention in relation to sustainability debates, where, for instance, low-carbon transitions are needed (to achieve 80% CO2 reductions). Large sustainability improvements are likely to require shifts to new transport, energy and agri-food systems. This presentation (and the articles) introduce a multi-level perspective (MLP) to understand the dynamics of transitions. The MLP argues that transitions come about through interactions between: a) niches, where radical innovations emerge (nurturing), b) existing regimes/systems that are characterized by lock-in, path dependence, inertia and incremental change, c) socio-technical landscapes, which are heterogeneous external contexts (e.g. macro-politics, macro-economics, demographics, environmental disasters) in which niches and regimes are embedded. I will presents a historical case study to illustrate the MLP.
Reading: (Geels 2002; Geels 2005; Geels and Schot 2007)

Tue 23 Jun, 9-10:30
Low carbon technology transfer – the application of a discursive analytic approach to the United Nations Framework Convention on Climate Change negotiations
By David Ockwell (Sussex)
http://www.sussex.ac.uk/sussexenergygroup/profile197916.html
Based on Dr Ockwell's involvement in the UN climate negotiations over the last three years, this lecture will introduce you to the issue of low carbon technology transfer – a critical aspect of efforts to reach an international agreement between developed and developing countries to replace the Kyoto Protocol when it expires in 2012. At the same time as providing an understanding of this important issue, the lecture will also demonstrate how a discursive approach can be taken to understanding policy conflicts.
Reading (core): (Ockwell, et al. in review; Ockwell, et al. 2008) http://www.sussex.ac.uk/sussexenergygroup/documents/ockwell_et_al_conflicting_discourses_of_dev_diffusion.pdf
Reading (recommended): (Ockwell 2008; Ockwell and Rydin 2006)

Tue 23 Jun, 11:00-12:30
Dynamic Sub-Properties of Sustainability: contrasting strategies for resilience and robustness
By Andy Stirling, SPRU – University of Sussex
http://www.sussex.ac.uk/spru/profile7513.html
This session will explore a framework for distinguishing analytic and practical policy implications of a series of contrasting properties of dynamic trajectories complex socio-ecological systems. It will be argued that a number of these properties are conventionally conflated in mainstream discussions of 'sustainability'. Although addressing many important insights, emerging interdisciplinary literatures on socio-ecological resilience also tend to elide certain important aspects of these properties. In particular, these established analytic perspectives tend to be ambiguous as to the specific normative connotations of sustainability. Fundamentally divergent ontologies of sustainability arising in contrasting knowledges, values and interests (of a kind that are intrinsic to complex socio-ecological systems tend) to be addressed in circumscribed ways as amounting simply to different 'scales', 'levels' or 'units' of analysis. System structure and system function tend to be treated effectively synonymous, obscuring possibilities to analyse frequent and important cases in which techno-institutional structures militate against socio-ecological sustainability. The proposed framework will address each of these

aspects - and illustrate the ways in which power relations operate in processes of social appraisal to 'close down' understandings and actions alike. It will be argued that greater attention to the distinction between actions oriented at 'control' and 'response' and between temporalities of 'shock' and 'stress' provide a valuable practical basis for thinking about these complex issues. A number of significant implications arise for development of practical governance strategies and policy instruments.
Reading (core): (Leach, et al. 2009, forthcoming)
Reading (recommended): (Gunderson 2006)
At:
http://books.google.co.uk/books?hl=en&lr=&id=Joh0_7X5DHMC&oi=fnd&pg=PR1&dq=fikret+berkes+johan+holding+carl+folke+navigating+social-ecological+systems&ots=0ttG-Lcaw5&sig=OtlzkhAwNoiwV4F7xHQuXaCdhrM#PPP1,M1
Whole book at:
http://books.google.co.uk/books?hl=en&lr=&id=Joh0_7X5DHMC&oi=fnd&pg=PR1&dq=fikret+berkes+johan+holding+carl+folke+navigating+social-ecological+systems&ots=0ttG-Lcaw5&sig=OtlzkhAwNoiwV4F7xHQuXaCdhrM#PPP1,M1

Wed 24 June, 9-10:30
China's Energy Transition: Pathways to Low Carbon Development
By Tao Wang and Jim Watson, SPRU – University of Sussex
http://www.sussex.ac.uk/spru/profile8157.html
http://www.sussex.ac.uk/spru/profile197917.html
China has experienced a sustained period of rapid economic growth, accompanied by large annual increases in energy demand. Coal continues to dominate the Chinese energy system, and accounts for the majority of new power generation capacity. Demand for imported oil is also increasing sharply. The environmental side effects of these trends are serious - both for China and for the international community. This lecture is based on a report that assesses alternative energy futures for China, examining the potentials for China to transform to make the transition to a less carbon-intensive, more sustainable energy path.
Reading (core): (Wang and Watson 2009)
http://www.sussex.ac.uk/sussexenergygroup/documents/china_report_forweb.pdf
Reading (recommended): (Anderson, et al. 2008; Bows, et al. 2006; Wang and Watson 2008)

Wed 24 Jun, 11:00-12:30
Methods for assessing complex systems – Multicriteria Appraisal
By Sigrid Stagl, SPRU – University of Sussex
http://www.sussex.ac.uk/spru/profile185233.html
When appraising more or less sustainable policy / technology options and comparing them against each other, traditional economic techniques such as cost-benefit analysis turned out to be unsuitable. Key reasons for this call for new tools and methods were: (1) the need to address uncertainty and to account for multiple framings resulting from the characteristics of complex adaptive systems; and (2) the increasing acceptance of the idea that preferences and institutions are intertwined; formal and informal institutions influence actors and shape preferences. This lecture reviews methodological options for sustainability appraisal that address uncertainty, capture the decision process as well as the outcome and account for social influence on decision-making. Viewing appraisal methods as value-articulating institutions moves them from technical detail to crucial policy choice.
Reading: (Munda 1996; Stagl 2009, forthcoming; Stirling 2005; Vatn 2004)

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