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Book of Abstracts
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Steering "real world" complex adaptive systems: developing bio-based economy in the humber region

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Many important problems for society involve the management of interlinked complex adaptive systems. Such systems have well known properties which make understanding and controlling them challenging. These include non-linear responses to change in variables, "emergent" effects which may feedback to those lower-level processes, the importance of network structure and crucially, the ability to adapt and evolve to changes in their environment. All of these properties present new challenges for policy intervention or engineering as they may give rise to behaviours which run counter to our intuition and experience and may change their responses as we intervene. Additionally many of the complex systems which we would most like to influence have significant social components and may require the integration of participatory or political processes with tools from complexity science.

In order to manage complex adaptive systems, we suggest a "steering" approach; applying a series of actions to a complex system and/or its environment to achieve a specific purpose. Steering is a continuous process which involves interacting with, monitoring and learning from the system in question. The techniques required for effective steering fall into two categories. Firstly we wish to understand, and indeed exploit, the systems' structure and dynamics in order to intervene effectively with them. Hence we need techniques to uncover this structure and to choose points of intervention. Secondly we frame those techniques within a participatory "adaptive management" structure which explicitly takes into account the adaptive nature of these systems and our limited capacity to fully model real world complex systems, by building in monitoring and feedback processes with which to modify our interventions as systems respond.

Using work on development of a bio-based economy in The Humber region of the UK, I will discuss the various modelling approaches which allow us to uncover system structure and a mathematical "control nodes" technique which allows us to choose a set of points of intervention within a given network. I will then describe how these can be used in a real world participatory context in which policy makers and industrial stakeholders must make decisions.

Exploring the coevolution of urban form and road networks with cellular automata

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The process of urbanisation is happening at an alarming rate, especially in many developing economies where internal migration is at its highest. In order to sustain a reasonable quality of life, these urban areas must be efficient; of which the transport network topology is a key driver. Urban form is determined by the transportation topology but the reverse is also true; recently developed models have attempted to capture this land use - transport (LUT) interaction. These models, however, are limited to considering the feedback loop between accessibility/congestion measures and land use. This study attempts to extend an early and influential land use model, based on cellular automata ideas, with a co-evolving transport network topology. Although the resulting model fails to capture the urban form dynamics as successfully or elegantly as the original model, it raises questions of how network topologies evolve from the decentralised process of rapid urban growth and how these dynamics may be understood and used for more effective transport policy.

ODD protocol application to review simulation model literature on complex social-technical systems within the metal recovery

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Electrical and electronic equipment (EEE) production is booming (UNEP, 2011). Such a product can contain more than 40 different metals and are mostly applied in very small quantities (UNEP, 2013). With the current material-centric recycling system, the recycling rate of speciality metals is below 1%. These metals include: indium and rare earth elements. They are used in high strength magnets and computer chips. These speciality metals are applied to enhance the performance of such products and thus play a vital role for modern society (Reck & Graedel, 2012). In order to recover these metals the present recycling system of a material-centric approach needs to shift to a product-centric approach. Thereby it is crucial to consider the complexity of modern products in relation to the complex interactions within the recycling system and the society (UNEP, 2013). To demonstrate the potential to increase the recovery rate of metals from EEEs during the recycling process, a clear structured model will be developed, taking into account socio-technological factors. Therefore, this research draws on the structured framework provided by the ODD (overview, design concept, details) protocol (Railsback & Grimm, 2011; Müller et al., 2013). The categories and questions of the protocol will be critically analysed and adapted if necessary (Grimm et al., 2010). Application of the ODD protocol allows a systematic and comprehensive review of the scientific literature (Müller et al., 2014) to develop the conceptual framework of the model. The focus of my presentation will be to discuss the strength and weaknesses of applying the ODD protocol, in order that other researchers will be able to reap the maximum benefits of this structured approach.

Title TBC

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In recent years, we have seen a surge in the number of natural disasters. Rapid urbanisation and population growth are contributing factors. Emergency planning tools available are usually specific to a region and incompatible in new areas. Therefore, we utilise a growing wealth of crowd-sourced open spatial databases like OpenStreetMap alongside computational mobility and behavioural models to achieve rapid simulation of large-scale evacuation effort in response to major crises. This is based on a new pedestrian model where agents move along a road-network, and the model is designed to take congestion effects into account while still being computationally efficient enough to be able to run numerous evacuation scenarios.

We envision `Evacuation-Friendliness Index‘ for major cities worldwide at the end of this project. Focusing on suitability of road networks for emergency evacuation and non-linear effects using agent based models, the outcome is expected to have implications on emergency planning in the short term by testing multiple strategies in the run up to a disaster and influence policy makers in the long term by identifying weakest links and bottlenecks in a city system.