Modeling industrial symbiotic processes from a complex systems perspective

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ABSTRACT

The 'circular economy' is recent approach on questions of sustainability. An important concept within the circular economy is industrial symbioses. Industrial symbioses is about creating an integrated byproduct and waste cycle between industrial actors.These so called 'closing the loop' mechanisms are aimed at maximizing economic value and minimizing environmental effects. The idea of these mechanisms corresponds to complex system paradigms, however complexity science has hardly been utilized in this field. In this project we brainstormed on how complexity science can contribute to the field of circular economy. We think there are many ways in which complexity science can contribute, both in methods and in theory.

A crucial factor in industrial symbiotic processes is the geographical proximity of the different industrial actors. Industrial symbioses is about the physical exchange of waste/byproducts. In order to efficiently exchange byproducts an industrial actor often has to look for the symbiotic possibilities in its direct geographical proximity. So 'closing the loop' mechanisms in industrial symbiotic exchanges have a clear spatial component. However, the role of this spatial component has never been formally researched. In this working paper we describe a toy model to model waste flow between actors on the level of organizations/businesses. Its purpose is to investigate how waste flow is affected by different parameters such as, distance, clustering, transportation cost and other parameters. Also the influence of different geographical setups will be studied, as can be seen from Figure 1.

In the full paper we explain the rationale of the basic model, present some exploration of the model and we present some preliminary results. Future developments will include the application to real world spatial maps and infrastructures, and calibration to data of first real-world implementations of 'circular economy practices'. The goal is to make a basis for an open source circular economy application that can be used to monitor the circular economy.

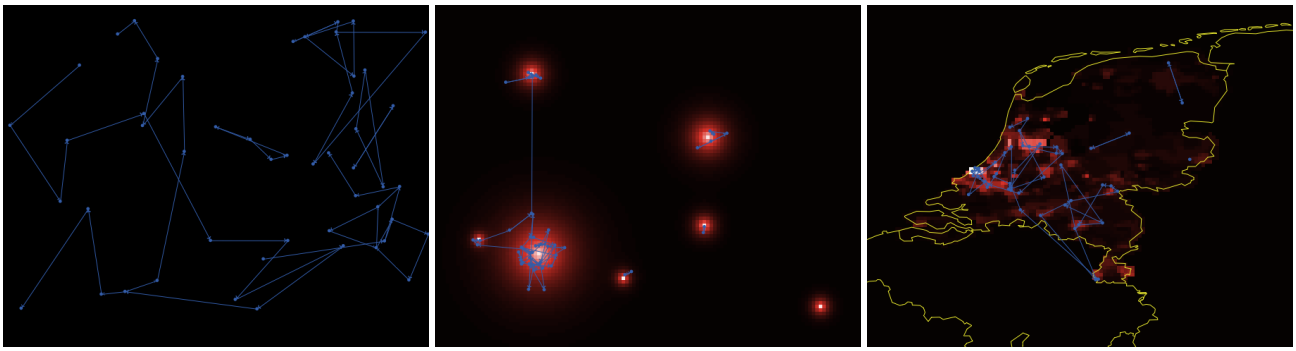

Figure 1. Examples for three possible geographical setups (from left to right, uniform, synthetic city system, real density data)