Paper Session

[C07] Towards a better understanding of circular business model implementation through employing technological innovation systems analysis -- a study on the innovation system for fiber reinforced plastics in the Netherlands

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The circular economy (CE) is a concept promoted for its potential to induce a new paradigm of resource use contributing to the transition towards more sustainable societies. It proposes the move away from a traditional linear 'take-make-dispose' production and consumption models towards closed loop systems. Forward and reverse supply chains are integrated as to enable multiple lifecycles for products through value cascading activities. Value cascading refers to the reuse of a specific product from higher to lower orders where the preservation of the product commonly denotes higher order value and the separation of a product into its parts for reintroduction in the same or a different production process represents lower orders of value retention. Implementing this principle requires not only technological innovation but likewise innovative ways of conducting business, both of which are operationalized in so called circular business models (CBMs).

Surprisingly, studies on the CE are almost absent in the transition community even though large environmental gains can be expected from CE and the transformation towards a CE has many features of a sustainability transition. This paper explores whether one of the commonly used transition frameworks, the technological innovation system framework (TIS), is suitable for understanding the rise of CE business models. The TIS is commonly applied to study the diffusion of technological innovation, processes and services at system level against the context of the established technological field. CBMs entail forms of innovation that can be viewed as challenging established technological fields and entire systems of production and consumption. The transition from a linear to a CBMis influenced by how the surrounding system – the innovation system – is structured and functions. Therefore, the TIS analysis, with its main elements structural analysis, functional and failure analyses, is in this paper put forward as a theoretical lens for analyzing the potential for CE business model implementation, wherein the functional analysis served to single out important drivers and barriers for CE business models perceived by the actors in the system.

This is the first time that TIS is used in the CE context, although there have been earlier attempts to use TIS for diverse types and combinations of innovations altering systems beyond technology. Respectively, the preliminary research question to be addressed in the paper is as follows:

How can a technological innovation systems analysis contribute to analyzing the implementation of circular business models?

In line with the established TIS approach, a case study has been conducted. The case study focuses on fiber reinforced plastic (composite plastic) which is used in wind turbines, cars and boats at increasing rate due to properties such as a high strength to weight ratio, corrosion resistance, and a long lifespan. The sector is growing by 15-20% globally per year and it has been estimated that about 10% of the total European end-of-life treatment of this material will be incurred by the Netherlands. These numbers indicate the relevance of reuse in the Dutch context and clarify a wider need for a propelling CE solution that could be applied by other (European) countries dealing with composite reuse.

The structural TIS analysis on the case was conducted mainly through desk research and included scientific peer-reviewed articles and a larger number of grey literature such as newspaper articles, reports and websites – mainly owed to the lack of scientific papers in the Dutch context. For assessing the TIS functions and failures, twelve semi-structured interviews were conducted with representatives from all relevant actor groups.

Findings show that in the Netherlands approximately 350 actors are involved in a structure supporting a well-functioning conventional linear production model. Despite the availability of various recycling and reuse technologies, there are no closed-loop solutions operational. The functional analysis revealed a fair amount of entrepreneurial activities, knowledge creation and diffusion (functions 1-3) but an absence of guidance and resource mobilization (function 5, 6) which seem to block CBM implementation and leave the system in a pre-development stage regarding CE solutions.

Reflecting on the case study results, the TIS analysis was apt to identify problems linked to CBM implementation identified by the interviewees. The results on the system functions match typical expectations on early stage TIS development. This suggests that the CE has a systemic character which can be captured by a TIS perspective. Further research should explore if TIS as a heuristic applies also at later stages of the system or was merely applicable in this particular case or at this particular stage. Likewise, first practical implementation of (policy) advice stemming from CE-TIS analysis is needed to confirm that action targeted at supporting particular functions could actually induce effects at the system level - as has been demonstrated in traditional TIS analysis focused on diffusion of a particular technology.