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Capturing Complexity and Interdependencies in Environmental Production Networks

Sabine Baumann
College of Management, Information, Technology
Jade University
Friedrich-Paffrath-Str. 101
26389 Wilhelmshaven, Germany
sabine.baumann@jade-hs.de

Christoph Wunck
College of Management, Information, Technology
Jade University
Friedrich-Paffrath-Str. 101
26389 Wilhelmshaven, Germany
wunck@jade-hs.de

Abstract

The objectives of the circular economy require manufacturers not only to shift from linear supply chain approaches towards inter-company production networks, but also to trace all flows of material and energy within the network as well as at its boundaries with the natural environment. Research on production networks has been limited in that studies focus on a single or a small set of production phases or production methods or that only linear cause-effect-relationship are being studied. Consequently, feedback and feedforward loops are insufficiently captured in these partial studies. This paper closes the gap by conceptualizing production networks that include the entire product lifecycle including the resulting complex structures and interdependencies. The paper introduces a framework with standardized modules (modelled as input-output systems) that can be combined into alternative product-independent production networks. Depending on the requirements modules of different granularity are presented. The paper then applies the framework to the case of car manufacturing and recycling. The merits of this innovative research are twofold. Such a material and energy flow framework was previously not available, thus the research promises original results. Furthermore, the results can serve as excellent input for companies in their planning and assessment of environmentally oriented production networks.

Keywords
Sustainability, Production Networks, Traceability, Input-output Modules

Biography

Sabine Baumann is Full Professor for Business Administration in the College of Management, Information, Technology at Jade University in Wilhelmshaven, Germany. She received her doctorate from Paderborn University in Germany with a project on environmentally oriented production networks. Before rejoining academia she worked for Bertelsmann, Germany's largest media conglomerate, in various positions including director of the Content Management Competence Center. The Center supports international customers with process adaptations to manage the disruptive challenges of the ongoing digital transformation. Her current research interests lie in big data analytics, environmental sustainability, and efficiency and differentiation challenges in smart manufacturing networks. She serves on the editorial board of the *Journal of Media Business Studies* and the *Journal of Media Innovations*. Her research has been published in leading journals such as the *Journal of Media Innovations*, *International Business and Economics Review*, and the *Journal of Business Economics*.

Christoph Wunck is a Professor of Business Computing Systems at Jade University of Applied Sciences, Wilhelmshaven, Germany. He holds a Master of Engineering degree (Diplom-Ingenieur) in Electrical Engineering and a PhD in Mechanical Engineering from RWTH Aachen University. His research interests include applications of machine learning in manufacturing and architectures for manufacturing execution systems.