

Fandel, Günter; Kleine, Andreas; Dellnitz, Andreas

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Editorial “sustainable decision-making in production and logistics”

Günter Fandel¹ · Andreas Kleine² · Andreas Dellnitz²

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Corporate decision-makers are focusing more and more on sustainably produced and transported goods to improve the company’s ecological footprint as well as protecting natural resources and, consequently, mitigating the impacts of climate change. In order to reach such goals progressively, respective cause-and-effect relationships between ecological and economic factors must be revealed and adequately embedded in the decision-making process. This is what the present special issue is about.

The special issue includes five socially and scientifically relevant papers on quantitative approaches in production and logistics with different subjects surrounding the field of sustainable decision-making, combining theories and methodologies from operations research, supply chain management, and engineering with ecological aspects. In all contributions, the theoretical findings are empirically well substantiated, drawing on business case studies and numerical analyses.

Hendrik Butemann and Katja Schimmelpfeng open the special issue with the paper “Long-term electricity production planning of a flexible biogas plant considering wear and tear” elaborating the combined long-term production and maintenance planning of a biogas plant. The gist of the matter is to identify the economical optimal schedule of energy producing hours for a biogas plant, determining the generation and storage of biogas as well as the strategy for maintenance activities simultaneously. Therefore, the authors propose a mixed integer linear program and study the system behaviour numerically, applying different price scenarios. They show that a flexible operation of the biogas plant under consideration leads to higher revenues and implies lower maintenance costs.

In the second paper of this special issue, Sven Schulz, Udo Buscher, and Liji Shen focus on an energy-oriented hybrid flow shop scheduling problem, studying in particular the impact of time-of-use energy prices and variable discrete production speed levels. In this context, the authors show that lower speeds can reduce energy consumption and, consequently, can improve the energy cost objective on the one

✉ Günter Fandel
guenter.fandel@fernuni-hagen.de

¹ Center of Production Economics and Decision Systems, University of Hagen, Hagen, Germany

² Chair of Operations Research, University of Hagen, Hagen, Germany

hand; but on the other hand, such a reduction then might increase the processing times, counteracting the goal of timely deliveries. In order to derive such statements and to analyse the interdependencies between all goals more precisely, they perform a numerical case study applying the so-called ε -constraint method to differently-sized instances.

In a similar line of research, from a generic perspective, Jens Rocholl and Lars Mönch develop a bi-criteria scheduling problem for parallel identical batch processing machines with application in the semiconductor industry. Accordingly, the authors formulate a mixed integer linear program applying the total weighted tardiness and electricity costs, considering a time-of-use tariff, as performance measures. In order to solve respective optimization problems, the authors design three heuristics based on a non-dominated sorting genetic algorithm II framework. Here, they show that their approaches in approximating the Pareto front perform very well in medium-sized instances, using the results of an exact method—the ε -constraint method—as benchmark.

A topic that combines energy-oriented lot-sizing and machine scheduling is covered in the paper “Energy costs vs. carbon dioxide emissions in short-term production planning: A business case study”. Andreas Dellnitz, Damian Braszczyk, Jonas Ostmeier, Markus Hilbert, and Andreas Kleine show that minimizing energy costs does not automatically lead to an improvement of the ecological footprint due to daily fluctuating carbon dioxide emissions. Therefore, based on a real-world business case, they develop a mixed integer optimization model to improve the ecological footprint in short-term production planning context, aiming for a good trade-off between carbon dioxide emissions and energy costs.

Andreas Schiessl, Richard Müller, Rebekka Volk, Konrad Zimmer, Patrick Breun, and Frank Schultmann close the special issue with a work on quantifying the CO₂ emissions of the iron and steel industry on a site-specific level with application to supplier selection. In their paper “Integrating site-specific environmental impact assessment in supplier selection: exemplary application to steel procurement”, they develop an approach to estimate CO₂ emissions—without the need of gathering confidential primary data—and demonstrate that the CO₂ emissions of steel production might deviate from site to site. In particular, the latter aspect emphasizes the importance of incorporating CO₂ emissions as a criterion in the supplier selection process in order to become more sustainable.

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