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Data article

Q1 Sustainable aggregate production planning in the chemical process industry - A benchmark problem and dataset

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A B S T R A C T

Process industries typically involve complex manufacturing operations and thus require adequate decision support for aggregate production planning (APP). The need for powerful and efficient approaches to solve complex APP problems persists. Problem-specific solution approaches are advantageous compared to standardized approaches that are designed to provide basic decision support for a broad range of planning problems but inadequate to optimize under consideration of specific settings. This in turn calls for methods to compare different approaches regarding their computational performance and solution quality. In this paper, we present a benchmarking problem for APP in the chemical process industry. The presented problem focuses on (i) sustainable operations planning involving multiple alternative production modes/routings with specific production-related carbon emission and the social dimension of varying operating rates and (ii) integrated campaign planning with production mix/volume on the operational level. The mutual trade-offs between economic, environmental and social factors can be considered as externalized factors (production-related carbon emission and overtime working hours) as well as internalized ones (resulting

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costs). We provide data for all problem parameters in addition to a detailed verbal problem statement. We refer to Hahn and Brandenburg [1] for a first numerical analysis based on and for future research perspectives arising from this benchmarking problem.

Specifications Table

Subject area	Operations Research
More specific subject area	Aggregate Production Planning
Type of data	Table, Figure
How data was acquired	A benchmark problem introduced by Papageorgiou and Pantelides [2] is complemented by other scientific sources
Data format	Raw
Experimental factors	Data can be aggregated for hierarchical aggregate production planning
Experimental features	Data contains a benchmark problem for hierarchical integrated aggregate production planning in the chemical process industry
Data source location	Not applicable
Data accessibility	Data is within this article

Value of the data

- The dataset at hand serves as a benchmark problem for hierarchical aggregate production planning in the chemical process industry. For this purpose, the data is represented by a state-task-network and complemented by further information for mid-term planning (esp. demand quantities and aggregate cost parameters).
- The dataset provides parameters that capture the stochasticity of the manufacturing system (e.g. equipment availability, variation of setup and processing times). Consequently, this dataset can be used for stochastic analyses of a manufacturing system.
- Furthermore, the dataset includes information about energy cost and carbon emissions as well as information on social factors, in particular overtime, that allow for an analysis with respect to sustainability issues.

1. Data

The benchmark problem presented in this paper arises from aggregate production planning (APP) in the chemical process industry. To avoid problems regarding data confidentiality and to ensure scientific rigor in the formulation of the benchmarking problem, we have combined published data from publicly available sources, in particular scientific manuscripts.

The production system and processes of the benchmark problem are based on a case example of a chemicals manufacturer. This case example has been used to numerically analyse procedures for short-term campaign scheduling over a planning horizon of about ten weeks see, e.g., [2,6,7]. However, the manufacturing system and processes of the case example are adequate to numerically illustrate and analyze mid-term APP approaches.

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