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Optimization of Business Transactional Processes in a Digital Supply Chain

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Abstract

A new continuous time multistage scheduling Mixed-Integer Linear Programming (MILP) model is proposed to optimize the business transactional processes in supply chains. The novelty of this approach is in using techniques from the Process Systems Engineering (PSE) and Operations Research (OR) communities to address a side of supply chain optimization (information flow) that has not been targeted previously. This model accounts for the allocation of resources in processing orders at each of the stages of a business transactional process. The objective of the model is to improve customer experience, using on-time-delivery (OTD) as a surrogate metric for this target. An illustrative example, featuring a subset of the business transactional steps in the Order-to-Cash (OTC) process is presented, showing the potential of using mathematical programming to improve supply chain performance. The model enables identifying bottlenecks in the processes and determining where additional resources should be allocated. The model can also be used as a valuable tool to assist customer service representatives in establishing realistic promise-to-delivery dates for their clients.

Keywords: scheduling, MILP, supply chain, optimization, business transactions.

1. Introduction

Supply chains have been traditionally modelled and optimized by the Process Systems Engineering (PSE) (Grossmann, 2012) and Operations Research (OR) (Owen and Daskin, 1998) communities, with the focus being on the optimization of material flow within the supply chain network. Literature has shown the need to expand this vision to also include the financial flows in supply chain optimization. Jahangiri and Cecelja (2014) show how financial models of supply chain can be used to understand the effect of supplier penalty and manufacturer lead time on the company profit. Kees et al. (2019) show the benefits of integrating material and financial flows to improve both the availability of drugs in a hospital supply chain as well as the hospital economic performance. Yi and Reklaitis (2004) show the impact that an integrated material and cash flow model can have on the design of chemical plants. Guillen et al. (2006) show the economic benefits of integrating process operations and financial decisions when optimizing a chemical supply chain. However, there is another type of flow that has been overlooked by the optimization communities: information flow. Supply chains are commonly managed via Enterprise Resource Planning (ERP) systems, which log the data associated with business processes. Previous work in this regard has focussed on

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