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# A holistic framework for short-term supply chain management integrating production and corporate financial planning

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## Abstract

Traditional approaches for SCM usually focus on process operations and neglect the financial side of the problem. In this work we present a novel approach for holistically optimizing the combined effects of operations and finances in SCM. To achieve such integration between different business areas, it is derived an integrated model for SCM, which incorporates process operations as well as budgetary constraints. The novelty of this formulation lies not only in the insertion of financial aspects within a SC planning formulation, but also in the choice of a financial performance indicator, i.e. the change in equity, as the objective to be optimized in the integrated model. The main advantages of this mathematical formulation are highlighted through a case study, in which the results obtained by the integrated model are compared with those computed by the traditional sequential strategy, in which the operations are firstly computed and the finances are fitted afterwards. The obtained results show the importance of devising broader modeling systems for SCM leading to increased overall earnings and providing further insights on the interactions between operations and finances.
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## 1. Introduction

The concept of supply chain management (SCM), which appeared in the early 1990s, has recently raised a lot of interest since the opportunity of an integrated management of the supply chain (SC) can reduce the propagation of unexpected/undesirable events through the network and can influence decisively the profitability of all the members. SCM looks for the integration of a plant with its suppliers and its customers to be managed as a whole, and the co-ordination of all the input/output flows (materials, information and finances) so that products are produced and distributed at the right quantities, to the right locations, and at the right time (Simchi-Levi et al., 2000).

A large body of literature exists on SC analysis and optimization (Bok et al., 2000; Tsiakis et al., 2001; Cheng et al., 2003; Guillén et al., 2005a, b, c, 2006). Traditional SC models focus solely on determining the profit or revenue-maximizing, or cost-minimizing production schedule in a SC that runs from suppliers to manufacturing plants to distribution facilities and finally to retail outlets. These models neglect the cash-flow consequences of the optimal production schedule, such us

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opportunity costs associated with missed investment opportunities, interest on debt, etc.

Until today, process operations and finances have been treated as separate problems and the modeling approaches supporting them have been traditionally implemented in independent environments. Although the need to account for financial aspects when constructing process operations models has been pointed out in the literature (Applequist et al., 2000; Shapiro, 2001; Shah, 2005), the integration of both areas has so far received little attention and is currently waiting for further study. However, the works of Romero et al. (2003) and Badell et al. (2004), which address the integration of financial aspects with short-term planning in the batch chemical process industry (CPI) are appreciated contributions to the field. At the design level, Yi and Reklaitis (2004) have also presented an integrated analysis of production and financing decisions regarding the optimal design of batch-storage networks.

An integrated tool for SCM would allow managers to "play" with different planning alternatives taking into account all the available information and having a clear idea of the consequences of each alternative being tested. With this aid, it is possible to properly assess the impact of the process operations decisions on the financial area and to shift the slave/blind position of the business level towards a more prevalent role in SCM. This new philosophy will make managers gain a competitive advantage compared with those that check neither the feasibility nor the optimality of the process operations decisions from the financial viewpoint.

The purpose of the present paper is to introduce budgetary considerations into a basic SC model and direct the management's attention in the production-planning process to the more general objective of maximizing the firm's net equity.

The paper is organized as follows. First, a standard deterministic SC scheduling–planning model is presented. Then, budgeting models are reviewed, and a budgeting model suitable for SCM is described. Next, the integrated deterministic model, which merges SC operations and finances, is presented. Finally, a motivating example is introduced and the results computed by means of the integrated model are compared with those determined by the traditional sequential approach, in which the SC planning model is firstly computed and the finances are fitted afterwards.

## 2. Scheduling and planning

The mathematical formulation presented in this work has been derived having in mind the structure of the four-echelon SC given in Fig. 1. However, the model could be extended to more complex SC structures. The aforementioned SC includes the following elements:

- A set of external suppliers which provide raw materials, intermediate and final products to plants, warehouses and markets.
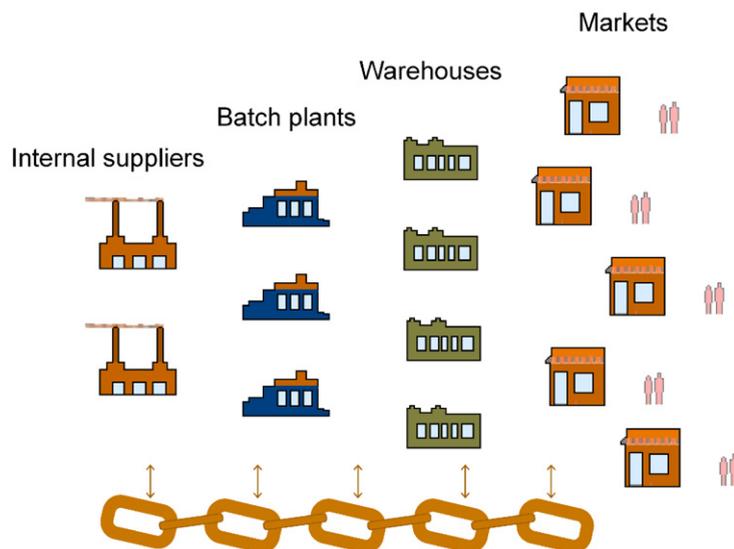


Fig. 1. Supply chain structure.