

Financial supply chain network design : assessment of sequential and integrated approaches

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1 Introduction

The way of financing large investments over a long-term horizon has a strong impact on the company's financial situation and future value. However, financial considerations are generally omitted in supply chain network design models. This work extends previous researches by jointly considering the cash flows arising from logistics and financial decisions. The objective function is to maximize the value of the company, represented by the Adjusted Present Value (APV).

2 Problem settings

We propose a mathematical model that enhances classical facility location models by considering financial decisions. Integrating financial and logistic decisions requires both a set of logistic constraints and a set of financial constraints. We show how the proposed model can be decomposed into logistic and financial sub-problems.

The main logistic decision variables concern *where* and *when* to locate the facilities and how to allocate customer to the selected facilities. The financial decisions are modeled by continuous variables that determine the firm's capital structure, i.e. the mix of debt and equity used to fund the investments (locating the facilities).

Integrating financial decisions into Supply Chain Network Design (SCND) problems requires computing the present value of the future operational and financial cash flows until a time horizon. Most multi-period SCND models consider a time horizon of a few years, e.g. 5 years. Even so, the logistic decisions taken in this time horizon will have a much longer impact on the cash flows of the company. This is the reason why we consider a double-scale time horizon, as represented in Figure 1.

The objective function is to maximize the Adjusted Present Value (APV) of the company. Introducing this financial indicator into an SCND problem is one of the contributions of this work.

3 Assessing the impacts of financial decisions into the SCND problem

We propose two optimization approaches : a direct (called integrated) approach maximizes the APV in a single step, and a decomposition approach (called sequential) consists of first

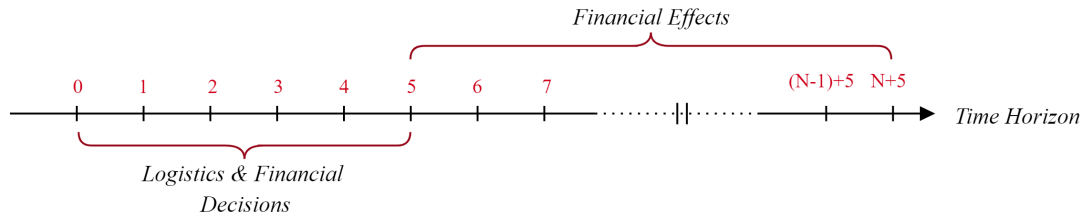


FIG. 1 – Logistic and financial time horizons

maximizing the revenue generated by logistic decisions, and then optimizing the financial decisions. The sequential approach mimics a classical decision makers decision process, who first optimize operations management decisions, and then optimize the financial resources that contribute to reach these operational objectives. Comparing the two approaches first enables us to evaluate the effects of integrating financial decisions into the SCND process. Second, decomposing the problem helps solve larger instances.

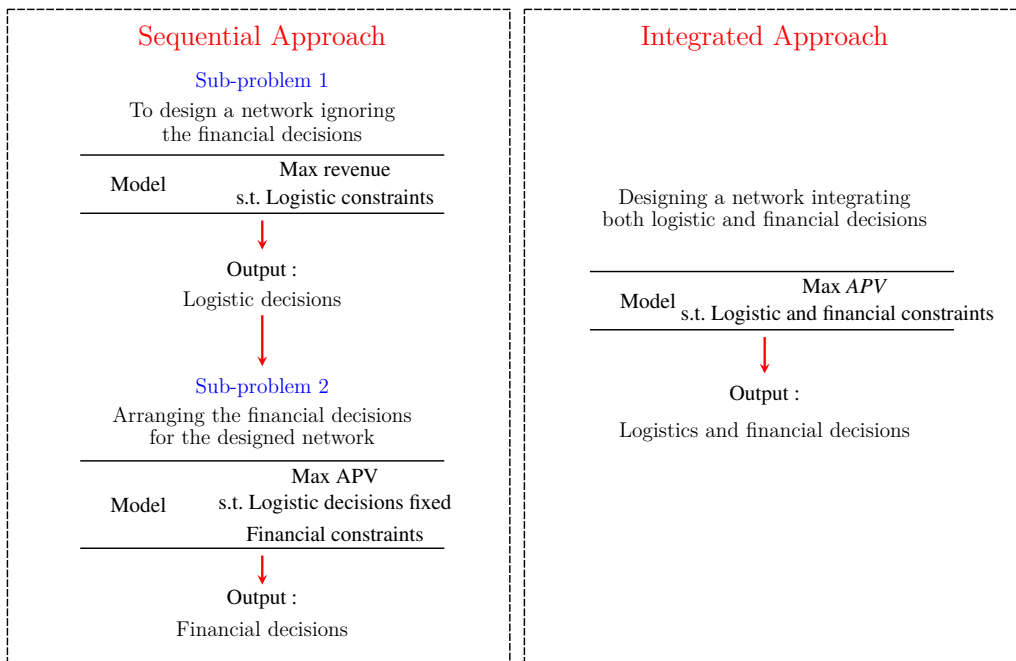


FIG. 2 – Sequential Approach vs. Integrated Approach

4 Numerical results and further research

The performance of the integrated and sequential approaches are evaluated on a set of generated instances, through various relevant logistical and financial indicators. We show that the sequential approach is more tractable and yields very close results to those of the integrated approach. We also show how the integrated approach tends to be less conservative and favors larger or earlier investments. This analysis shows that coordination between supply chain decisions and financial decisions slightly alters the supply chain network configuration and increases the firm value.