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An exact algorithm for the **Stochastic Inventory Routing Problem** with **Transshipment**

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INTRODUCTION

Vendor Managed Inventory problem is considered, where a supplier manages the inventory level of the retailers using **Transshipment** as a recourse action when **Demand Uncertainty** leads to shortages. A **Two – stage stochastic programming** model is introduced, while an **L – Shaped** algorithm is developed to solve the problem exactly.

BACKGROUND

- IRP was introduced 30 years ago (Bell et al. 1983).
- First exact algorithm was developed by **Arhetti et al** . (2007) using Branch and Cut scheme.
- **Coelho and Laporte** (2012) introduced the concept of transshipment in the context of inventory routing problem.
- **Campbell et al.** (1998) set the basis for the rolling horizon framework.
- **Kleywegt et al.** (2004) formulated the SIRP as a Marcov Decision Process over an infinite horizon.
- **Hvattum et al.** (2009) presented a solution framework based on scenario tree.
- **Solyali et al.** (2012) introduced the robust inventory routing to deal with demand uncertainty.
- **Adulyazak, Cordeau & Jans** (2012) used the Bender Decomposition to incorporate demand uncertainty in the context of Production Routing Problem.

OBJECTIVE

Minimize the distribution and inventory cost during the planning horizon as well as the expected lateral transshipment cost of recourse actions, in order to avoid stock – out occurrence at any retailer.

FIRST STAGE DECISIONS

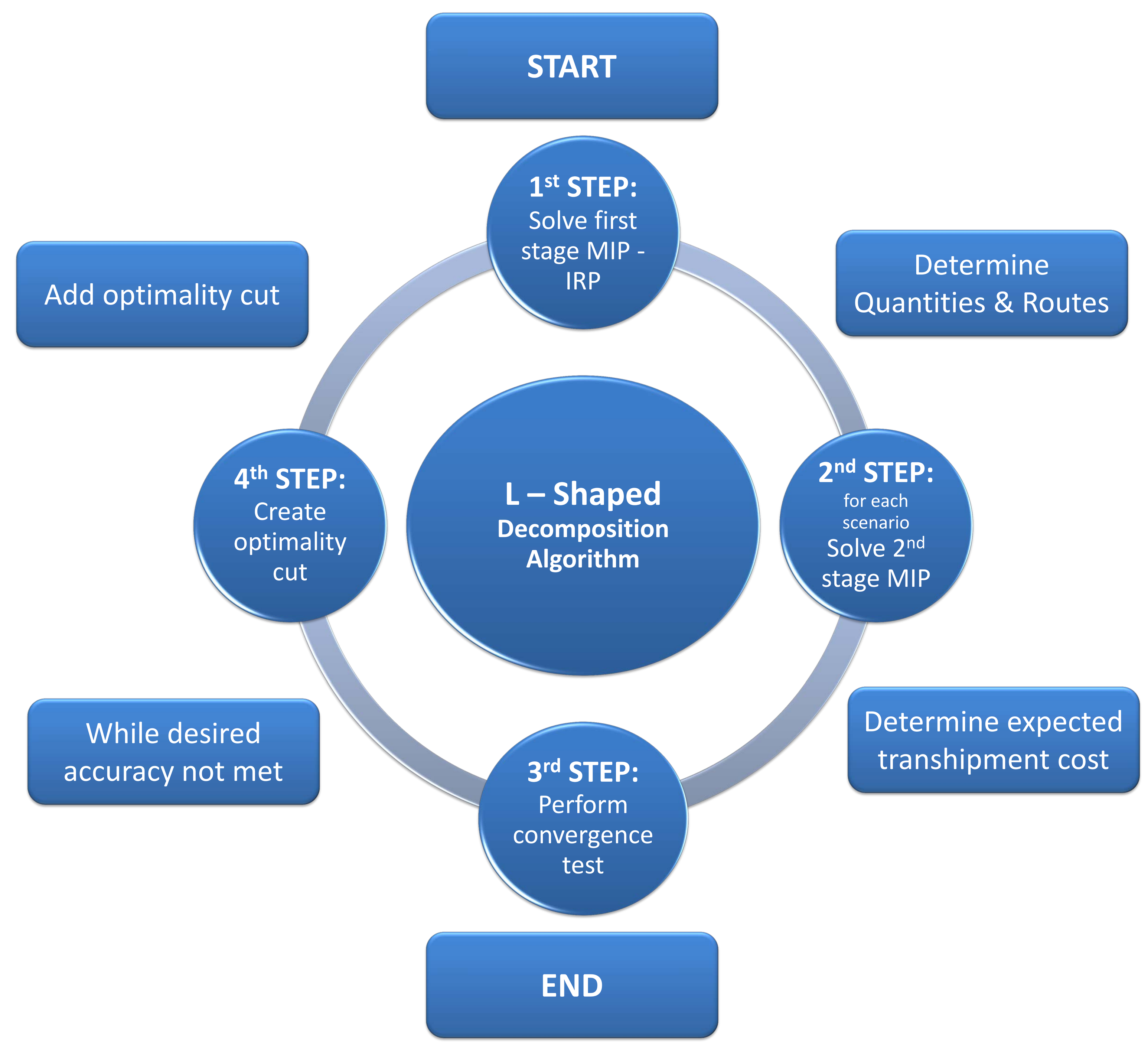
1. When to serve a retailer.
2. How much to deliver to retailer when served.
3. Which delivery route to use.

SECOND STAGE DECISIONS

1. Which retailer will facilitate the transshipment process.
2. How much to tranship to avoid shortages.

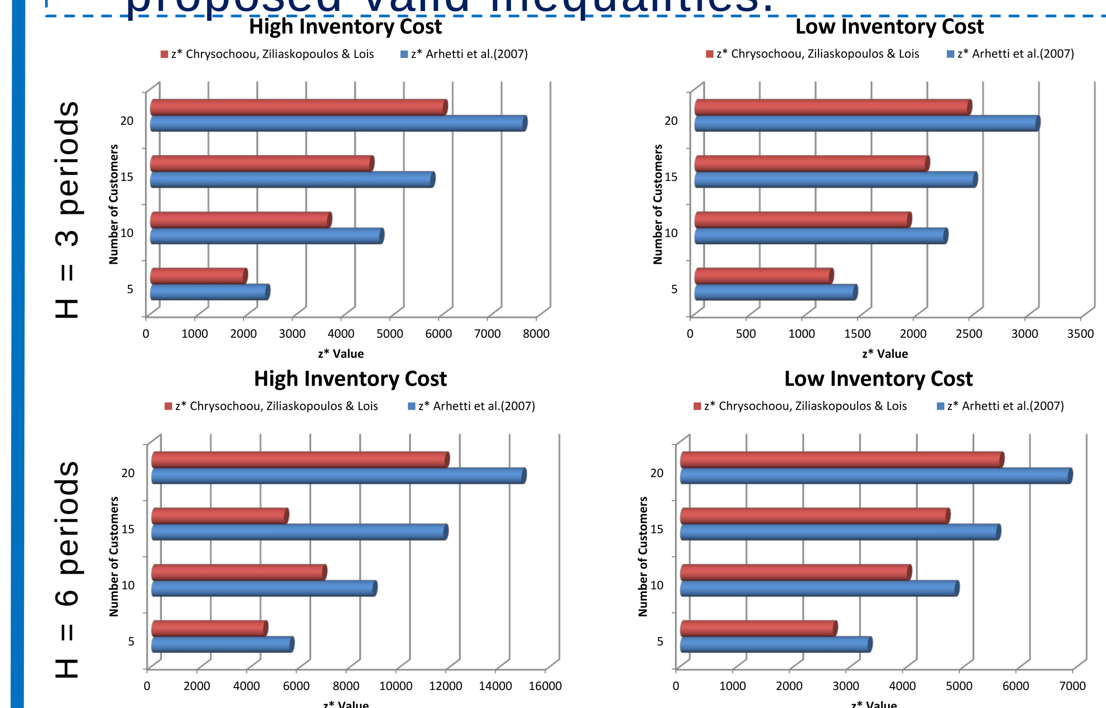
CONTRIBUTION

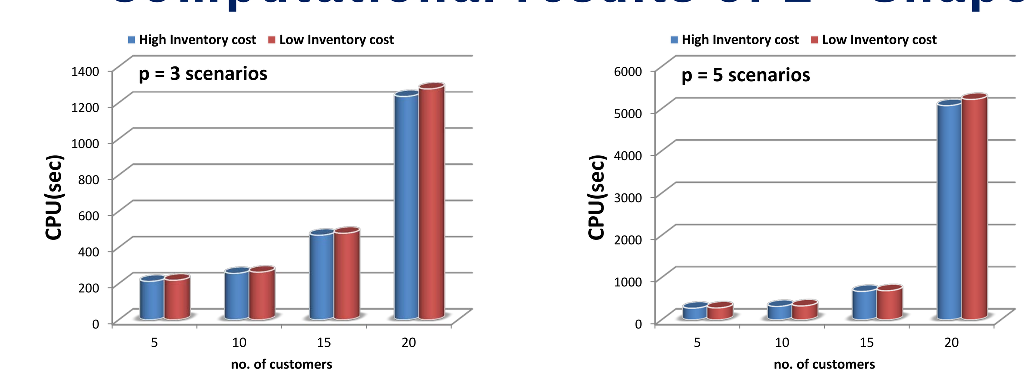
- Introduce a formulation for the SIRP as a stochastic programming model with recourse using transshipment as recourse action.
- Introduce new valid inequalities to enhance the computational process of the optimal transported quantities under Maximum Level policy.



RESULTS

- Algorithm was coded in C++ using Concert Technology and CPLEX 12.4.
- Benchmark instances of Arhetti et al. (2007) were used to evaluate the proposed valid inequalities.





Computational results of L - Shaped

CONCLUSIONS

- Computational experiments indicate that the decision of accounting for forthcoming time period demand to determine the delivered quantities improves the optimal value by an average of 15%.
- Transshipment was proved to be a powerful recourse action when demand uncertainty exists.

MORE INFORMATION

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