Using Automatic Planning for Supply Chain Management

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Abstract

The supply chain management is an integral part of success and customer satisfaction of an organization. This challenge requires reasoning and planning to obtain responsiveness and efficiency to attend the final consumer, which includes dealing with balance the stock level. In this proposal, we intend to use automatic planning through an existing planner to find plans that help in the management of a supply chain. We expect that the generated plans could help parties in a supply chain to maximize their outcomes.

Introduction

The supply chain is a network composed of organizations that are involved through different process and activities, which focuses on produce value in the form of products and services to the final consumer (Christopher 2016). The focus of supply chain is upon the management of relationships in order to maximize the outcome of all organization in the network. This is a significant challenge due to the possibility of the conflict and impasses among the organizations, requiring a win-win situation among them (van der Veen and Venugopal 2000). In this work, we cover two entities that have different function in the supply chain network: retail and vendor.

The role of the retail in the supply chain is to comply with the final consumer necessity, providing products or services. The retail must deal with issues regarding optimization of stock quantity, such as avoiding stock-out or excess of stock. The stock-out results in a loss of sales and consequently decreases the quality level of the retail due to not attend the final consumer demand. On the other hand, the excess of stock results in an unnecessary cost for the retail and may cause loss of products given the products expiration time.

The vendor is crucial to address these problems related to retail because his role is to provide products and attend the demand of retail. Given the fact that the retail controls his stock by ordering necessary products to his vendors, they may become a bottleneck in a supply chain if it has a problem to attend these orders.

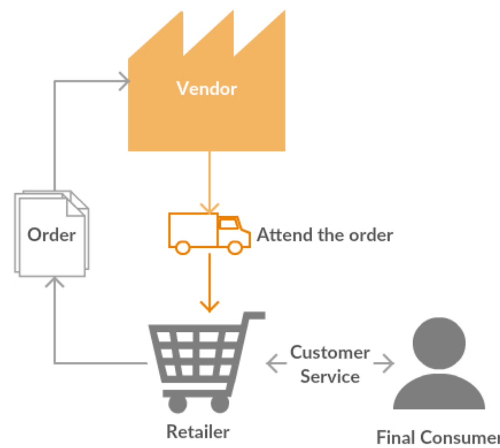

Figure 1: Diagram describing the supply chain flow among the final customer, retail and vendor.

Both the retail and vendor must plan a set of acts to deal with the issue of balance stock level. We propose to manage a supply chain through automatic planning to generating plans based on actions that involve inventory order and stock replenishment among the parties in a supply chain.

Technical Approach

To reach a plan to deal with the stock level, we use numerical planning (Fox and Long 2003) through an existing planner to find a optimal plan regarding the balance of stock of a organization in a supply chain. We will use PDDL (Planning domain definition language) (McDermott et al. 1998) to describe our planning domains and test scenarios through a problem definition. The PDDL version for our domains should support numeric fluents to use numeric representation and planning metric definition to measure plan quality criterion (Gerevini, Saetti, and Serina 2008).

Given the supply chain context, we will define the planning domain that contains actions for replenishment stock of retail and attendance the final consumer. Our planning domain must contemplate the entire supply chain, managing stock levels both of the retail and vendor considering the flow of resources between them.

In our planning domain, we pretend to represent stock level through numeric information, which should contain actions that will modify the problem values. For instance, an offer action from a retailer must increase his stock quantity and decrease the resources from the vendor. Based on numerical fluent of PDDL (Gerevini, Saetti, and Serina 2008), we will use two stock threshold to control the flow of stock quantity to avoid stock-out or an excess of stock events. These thresholds will define the maximum and minimum value of the stock level that a retailer should keep to execute the order action. It is part of our validation process to explore the use of different values for these thresholds to analyzing the supply chain responsiveness.

We propose to use the PDDL mechanism for expressing the plan quality through an optimization metric. We will optimize a generated plan through minimizing cost based on actions such as *order* and *replenishment* between a retail and a vendor.

Related Work

The work of *Radzi et al* (Radzi, Fox, and Long 2007) covers supply chain optimization domains through temporal planning structure. They explore the features of planners CRIKEY, LPG-td and SGPlan related to temporal constraints, numeric optimization, and coordination of concurrent actions. To attend the submission deadline, we will maintain the simplicity, exploring only the numeric optimization feature of planners. Temporal constraints and concurrent actions are out of our scope.

Project Management

Considering that we have five weeks until the submission deadline, our project management consists in the following phases:

1. **Planner Selection**: In this phase, we will test the planners LPG-td (Gerevini et al. 2004) and ENHSP Planner [1] and select one of them to the next phases.
2. **Domain Definition**: In this phase, we will study the extensions of PDDL that were supported from selected planner and we will define the planning domain and planning problems.
3. **Analysis of Results**: In this phase, we will collect the generated plans for each problem definition using the defined planning domain.
4. **Writing the paper**:In this phase, we will describe the planning domain defined and results of generated plans in a paper.

Table 1: Cronogram with the four defined task and the five remaining weeks.

Task/Week	**1**	**2**	**3**	**4**	**5**
Task 1	X				
Task 2	X	X			
Task 3			X		
Task 4				X	X

Conclusion

In this paper, we propose the use of automatic planning to generate an optimal plan given the stock level of the supply chain parties. The generated plan should help an organization to avoid events such as stock-outs and excess stock. Given the definition of a planning problem in a supply chain context, we expect to find optimal plans through a well-defined planning domain.

[1] Available on: https://gitlab.com/enricos83/ENHSP-Public

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