

Supvelikos: Portfolio Selection and Stratified Price Exploration for the SCML 2026 OneShot Track

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June 12, 2026

Abstract

This paper presents Supvelikos, a negotiation agent developed for the OneShot Track of the ANAC 2026 Supply Chain Management League (SCML). In a OneShot world, bilateral negotiations with multiple partners proceed in parallel, and both shortages and excess contracts can reduce profit. Instead of evaluating offers independently, Supvelikos enumerates subsets of offers received in the same round and treats them as contract portfolios. It selects an acceptance set using the quantity mismatch, quantity-weighted contract value, and utility. For counteroffers, the agent redistributes its remaining need across active partners and explores stratified regions of the feasible price range. It also uses each partner’s success and failure history as a weak allocation signal, preserving exploration while adapting to previously unseen opponents.

1 Introduction

SCML is a competition in which autonomous factories negotiate procurement, production, and sales contracts within a supply chain. In the OneShot Track, transactions for each production step are negotiated through multiple concurrent bilateral negotiations. An agent must consider not only unit prices but also shortfall penalties, disposal costs for excess products, production capacity, and exogenous contracts. Consequently, accepting an attractive offer in isolation may still create an unprofitable shortage or surplus at the portfolio level.

We propose Supvelikos, which models the concurrent negotiations as a portfolio selection problem. Its design has three primary objectives:

1. Reduce shortages and surpluses while improving total portfolio value.
2. Explore multiple price regions simultaneously against unknown partners.
3. Adapt without relying on opponent names or a particular local lineup.

2 Design of Supvelikos

2.1 Overall Procedure

Supvelikos does not process each negotiation independently. It applies Algorithm 1 separately to procurement and sales. The agent first gathers the offers available in the current round and searches for a subset whose total quantity is close to its need. It accepts the selected offers, recalculates the remaining quantity, and reallocates it among unresolved negotiations. Counteroffer prices are drawn from different regions of the price range, increasing the amount of market information obtained in the next round.

Algorithm 1 Round-level decision procedure of Supvelikos

Require: Current offers $\mathcal{O}$, need n for each trading direction, relative time t

Ensure: A response for every negotiation partner

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1: for trading direction  $d \in \{\text{procurement, sales}\}$  do
2:    $\mathcal{O}_d \leftarrow$  valid current-step offers in direction  $d$ 
3:    $m \leftarrow$  allowable quantity mismatch from penalties and  $t$ 
4:    $\mathcal{C} \leftarrow \{S \subseteq \mathcal{O}_d \mid |q(S) - n| \leq m\}$ 
5:   if  $\mathcal{C} = \emptyset$  then
6:      $S^* \leftarrow \emptyset$ 
7:   else
8:      $S^* \leftarrow \arg \max_{S \in \mathcal{C}} \{-1000|q(S) - n| + v(S) + 0.01\Delta u(S) - 0.02|S|\}$ 
9:   end if
10:  for all  $o_i \in S^*$  do
11:    Accept offer  $o_i$ 
12:  end for
13:   $n_{\text{rem}} \leftarrow \max\{0, n - \sum_{o_i \in S^*} q_i\}$ 
14:  Allocate  $n_{\text{rem}}$  among unresolved partners using reliability
15:  Stratify the price range and return a counteroffer to each partner
16: end for
17: End all negotiations that remain unprocessed
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2.2 Initial Offers and Overordering

At the start of negotiation, a seller proposes the maximum feasible price, whereas a buyer proposes the minimum feasible price. The total quantity $Q(t)$ proposed for a current need n is

$$Q(t) = \text{round} [n \{1 + \alpha_{\max} - (\alpha_{\max} - \alpha_{\min})t^\gamma\}], \quad (1)$$

where $t \in [0, 1]$ is relative negotiation time, $\alpha_{\max} = 0.30$, $\alpha_{\min} = 0.01$, and $\gamma = 0.38$. Early in negotiation, Supvelikos proposes more than its need to tolerate potential failures. The excess is reduced near the deadline to limit the risk of overcontracting.

2.3 Portfolio Evaluation of Offer Sets

Let $\mathcal{O}$ be the set of offers received in a round and $S \subseteq \mathcal{O}$ a subset. Supvelikos enumerates the subsets and selects the candidate maximizing

$$J(S) = -1000|q(S) - n| + v(S) + 0.01\Delta u(S) - 0.02|S|. \quad (2)$$

Here, $q(S)$ is the total quantity and $\Delta u(S)$ is the utility gain over the empty-contract baseline. The quantity-weighted contract value is $v(S) = \sum_{i \in S} q_i p_i$ for sales and $v(S) = -\sum_{i \in S} q_i p_i$ for procurement. The large coefficient on the quantity mismatch first favors portfolios that fit the need. Among portfolios with similar quantities, the agent prefers higher sales revenue or lower procurement expenditure. Using total contract value rather than an unweighted average price prevents a small favorable offer from masking a large unfavorable one.

The allowable mismatch depends on the shortfall penalty c_s , disposal cost c_d , and negotiation time:

$$m(t) = L \left[0.04 + 0.08 \frac{\min(c_s, c_d)}{\max(c_s, c_d)} + 0.24t^{3.2} \right], \quad (3)$$

where L is the number of production lines. The agent requires an almost exact quantity match early in negotiation and gradually expands the tolerance near the deadline.

2.4 Distribution of the Remaining Need

Whenever quantities are allocated among negotiation partners, Supvelikos uses a weak reliability estimate. For partner j , the estimate is

$$r_j = \frac{s_j + 1.5}{s_j + f_j + 3.0}, \quad (4)$$

where s_j and f_j denote the numbers of successful and failed negotiations. Strong reliance on this estimate would be unsafe because OneShot worlds provide few observations. The actual allocation therefore retains 0.78 of an approximately equal distribution and mixes in only 0.22 of the learned weight. An additional random exploration component is used early in negotiation to avoid repeatedly concentrating offers on the same partner.

2.5 Stratified Price Exploration

When several partners remain active, the feasible unit-price range $[p_{\min}, p_{\max}]$ is partitioned into as many intervals as there are partners. The partners are randomly permuted, assigned to different intervals, and offered a price sampled from their assigned interval. This prevents all prices from accidentally clustering in the same region, as can occur with independent uniform sampling, and explores a broad range of acceptable market prices without assuming a particular opponent strategy.

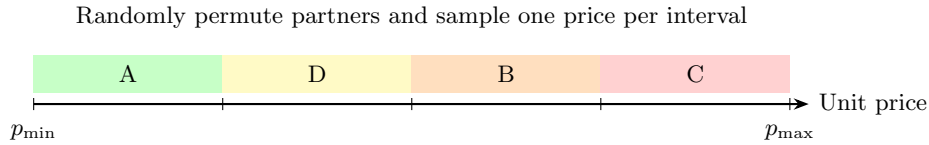


Figure 1: Example of stratified price exploration for four partners

3 Evaluation

3.1 Experimental Setup

We used the SCML tournament framework for evaluation. Development variants of Supvelikos were excluded; the opponents were limited to the standard OneShot agents distributed with the SCML library. This avoids a comparison dominated by closely related implementations and tests performance against representative greedy, random, and quantity-distribution policies. Two competing agent types were placed in each world, producing 504 worlds across the generated roles and configurations. Table 1 summarizes the setup.

Table 1: Experimental setup for the standard-baseline evaluation

Item	Value
Production steps	30
Base configurations	3
Maximum worlds per configuration	8
Competing agent types per world	2
Compared agent types, including Supvelikos	7
Total executed worlds	504
Score records	1008

The six baselines were GreedyOneShotAgent, GreedySyncAgent, RandDistOneShotAgent, EqualDistOneShotAgent, RandomOneShotAgent, and SyncRandomOneShotAgent. These results are from a local preliminary experiment and do not represent an official competition ranking.

3.2 Results

Table 2 and Figure 2 show the mean scores. Supvelikos ranked first with 1.05008, exceeding the second-ranked SyncRandomOneShotAgent (1.02204) by 0.02804. EqualDistOneShotAgent and RandDistOneShotAgent also achieved scores near 1.02, but Supvelikos obtained the highest value by combining portfolio selection with stratified price exploration.

Because this was a single tournament containing randomized decisions, the observed difference alone does not establish statistical significance. Nevertheless, ranking first without any development variants in the lineup supports the view that the strategy is not restricted to the names or implementations of local opponents.

Table 2: Local evaluation against standard OneShot agents

Rank	Agent	Mean score
1	Supvelikos	1.05008
2	SyncRandomOneShotAgent	1.02204
3	EqualDistOneShotAgent	1.02161
4	RandDistOneShotAgent	1.02003
5	GreedySyncAgent	0.83021
6	GreedyOneShotAgent	0.81314
7	RandomOneShotAgent	0.76100

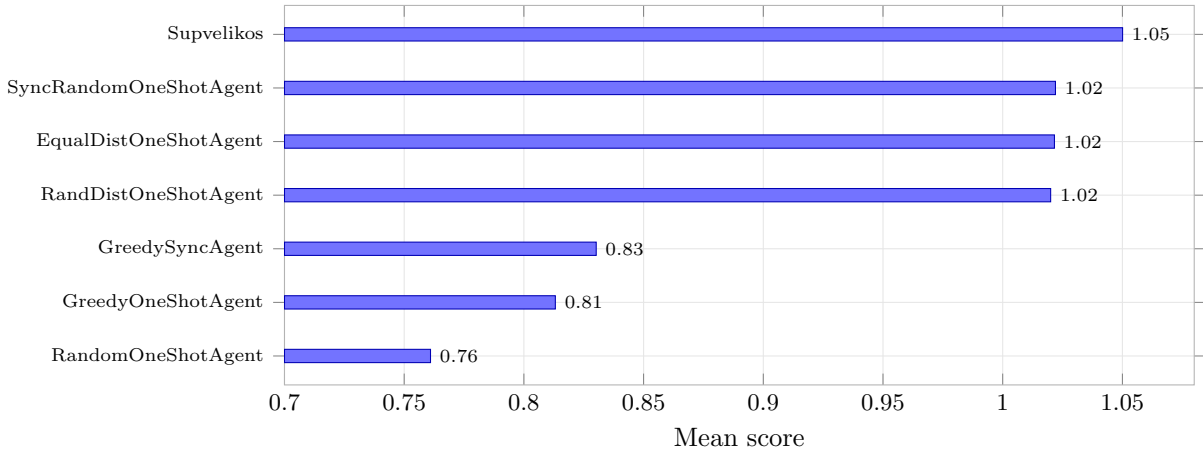


Figure 2: Mean scores against the standard baselines in 504 worlds

4 Discussion

The results suggest that matching the contracted quantity to the current need is as important as optimizing unit price in the OneShot environment. A policy that evaluates only the utility of currently available offers may not represent the option value of unresolved negotiations and can commit too early. Supvelikos mitigates this issue by using quantity mismatch as the primary criterion and contract value and utility as secondary criteria.

Among the standard baselines, the three policies that distribute quantities across multiple partners outperformed the greedy and purely random policies. This suggests that quantity allocation under possible negotiation failure is important in addition to price. Supvelikos extends this idea by evaluating received offers as combinations and distributing its counteroffer prices. It therefore addresses both quantity consistency after agreements and market exploration before agreements.

5 Conclusion

This paper introduced Supvelikos for the SCML 2026 OneShot Track. Supvelikos evaluates combinations of simultaneous offers as contract portfolios and selects an acceptance set using quantity mismatch, quantity-weighted contract value, and utility. It further combines redistribution of the remaining need with stratified price exploration to search a broad price range against unknown partners. In a standard-baseline evaluation excluding all development variants, Supvelikos ranked first across 504 worlds with a mean score of 1.05008, outperforming the second-ranked agent by 0.02804. Future work includes confidence intervals over multiple seeds, more efficient subset search, opponent models that use concession sequences, and statistical evaluation on fixed worlds. In particular, the computational growth of subset enumeration and variance introduced by randomized price exploration should be reduced.

References

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- [2] NegMAS Documentation, <https://negmas.readthedocs.io/>.