AS0 Agent Strategy Report
ANAC 2025 Supply Chain Management League — Standard Track

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1 Objectives and Assumptions

In the ANAC–SCML Standard Track, each agent *buys raw materials*, *manufactures products*, and *sells them to customers* within a shared market. AS0 is an autonomous negotiating agent that continuously observes

- the number of production lines L,
- the total simulation horizon N,
- the current step t, and
- the inventory level I_t,

while negotiating concurrently with multiple suppliers and customers (collectively, *partners*). AS0 pursues two—often conflicting—goals:

1. **Profit maximization**.
2. **Survival assurance**, i.e. avoiding raw-material depletion (line stoppage) and excessive inventory (cash–flow squeeze).

This report details the four strategic pillars AS0 uses to balance those goals.

2 Dynamic Negotiation-Cap Control

2.1 Motivation

Negotiating with too many partners dilutes attention, slows concession finding, and can inflate inventory risk through over–contracting. AS0 therefore limits the number of *simultaneous* negotiations to a context–dependent cap τ_t derived from inventory pressure and time pressure.

2.2 Formulation

1. **Base threshold**

$$\hat{\tau} = 0.1\,L.$$

2. **Inventory factor**

   Given the inventory ratio $r_t = I_t/L$,

$$f_{\text{inv}}(r_t) = \begin{cases} 1.5 & (r_t < 0.3) \quad \text{Raw–material shortage,} \\ 0.7 & (r_t > 0.8) \quad \text{Overstock,} \\ 1.0 & \text{otherwise.} \end{cases}$$

3. **Time factor**

   With the remaining–horizon ratio $\phi_t = (N - t)/N$,

$$f_{\text{time}}(t) = \begin{cases} 0.8 & (\phi_t < 0.2), \\ 1.0 & (0.2 \le \phi_t < 0.6), \\ 1.3 & (\phi_t \ge 0.6). \end{cases}$$

4. **Final cap**

$$\boxed{\tau_t = \max\bigl\{1,\ \bigl\lfloor \hat{\tau}\, f_{\text{inv}}(r_t)\, f_{\text{time}}(t) \bigr\rfloor\bigr\}}.$$

AS0 rejects or defers negotiation invitations that exceed τ_t, keeping computational and decision resources focused on the most relevant talks.

3 Partner Evaluation and Selection

3.1 Online Success–Rate Estimation

For partner i, let s_i be the number of successful deals and n_i the number of trials:

$$\sigma_i(t) = \frac{s_i(t)}{n_i(t)}, \qquad \sigma_i(t+1) = \frac{s_i(t) + \mathbb{1}[\text{deal succeeded}]}{n_i(t) + 1}.$$

This empirical success rate estimates how reliably a partner honours agreements.

3.2 Daily Adoption Ratio

To balance exploitation of reliable partners and exploration of new ones, AS0 modulates the *daily adoption ratio* p_{today} around a default $p_0 = 0.70$:

$$p_{\text{today}} = \begin{cases} \min(0.90,\, p_0 + 0.15) & \text{(Aggressive mode),} \\ \max(0.50,\, p_0 - 0.10) & \text{(Conservative mode),} \\ p_0 & \text{(Neutral).} \end{cases}$$

The number of primary partners is

$$k = \max\bigl\{1,\ \lfloor |P|\, p_{\text{today}} \rfloor\bigr\},$$

chosen by descending σ_i. Up to two additional partners are sampled randomly for exploration.

4 Proposal Generation

4.1 Even Allocation of Today ' s Needs

The unmet demand for step t, Q_t, is evenly split over the selected partner set P_t:

$$q_{i,t} = \Big\lfloor \frac{Q_t}{|P_t|} \Big\rfloor,$$

distributing any remainder from the top of the sorted list to avoid oversized requests.

4.2 Forward Contracting

Because supply chains have non–negligible lead times, AS0 reserves capacity in advance. Partners are sorted by σ_i and partitioned into proportions $\{50\%, 30\%, 20\%\}$ for steps $t+1$, $t+2$, $t+3$. The quantity per step is capped by

$$P_{\text{prod}} = L \times \text{productivity } (= 0.7),$$

preventing purchases that exceed expected production capability.

5 Price Determination — *smart_price*

The *smart_price* mechanism trades off immediate margin versus long–term relationship value.

Role	First offer	Counter–offer formula
Buyer (materials)	$p_{\min}$	$p' = p_{\min} + \beta(1-\sigma_i)\,\Delta p$
Seller (products)	$p_{\max}$	$p' = p_{\max} - \alpha(1-\sigma_i)\,\Delta p$

Here $\Delta p = p_{\max} - p_{\min}$ and $\alpha, \beta \in [0.1, 0.2]$.

- High–reliability partners ($\sigma_i \to 1$) receive favourable prices to cement the relationship.
- Low–reliability or unexplored partners ($\sigma_i \to 0$) see smaller concessions, hedging risk through price.

6 Adaptive Risk Management via Mode Switching

6.1 Profit–Trend Detector

Using the most recent five profits $B_{t-4}, \ldots, B_t$,

$$\Delta B = \frac{1}{3}\sum_{j=0}^{2} B_{t-j} - \frac{1}{2}\sum_{j=3}^{4} B_{t-j}.$$

6.2 Decision Rule

$$\begin{cases} \textbf{Aggressive} & \Delta B > +50, \\ \textbf{Conservative} & \Delta B < -50, \\ \textbf{Neutral} & \text{otherwise.} \end{cases}$$

- **Aggressive**: enlarge τ_t, widen exploration, and concede more in price.
- **Conservative**: shrink τ_t and price more cautiously.

This quick switch aligns resource allocation and pricing policy with the short–term market trajectory.

7 Counter–Offer and Response Policy

1. **Price feasibility test**: reject if $p_{\text{offer}} \notin [p_{\min}, p_{\max}]$.
2. **Need fulfilment priority**: if today's demand remains unmet, accept offers slightly outside the ideal to avoid line stoppage.
3. **Re–allocation of forward contracts**: re–apply the logic of §**??** whenever surplus or shortfall emerges, keeping supply–demand balanced.

8 List of Symbols

Symbol	Description
L	Number of production lines
N	Total simulation steps
I_t	Inventory at step t
τ_t	Cap on simultaneous negotiations
σ_i	Success rate of partner i
p_{today}	Daily partner adoption ratio
$q_{i,t}$	Quantity allocated to partner i at t
$p_{\min}, p_{\max}$	Feasible price range
Δp	Price span $p_{\max} - p_{\min}$
B_t	Profit at step t

9 Conclusion and Contributions

AS0 integrates

1. **Dynamic negotiation caps** tuned to inventory and time,
2. **Success–rate–based partner ranking plus diversity preservation**,
3. **Relationship–aware pricing** (*smart_price*), and
4. **Profit–trend–driven mode switching** for risk control,

forming a multi–layer policy that reconciles short–term profit with long–term stability. This design lets AS0

- explore aggressively in early rounds,
- exploit throughput efficiently in the mid–game, and
- avoid cash–flow crises near the end,

yielding a consistently high overall score.