International Journal of Economics, Business and Innovation Research
https://e-journal.citakonsultindo.or.id/index.php/IJEBIR
E-ISSN : 2964-0865
IJEBIR

Optimizing Packaging Material Order Allocation Using Analytic Hierarchy Process and Goal Programming in Manufacturing

Dian Maulidia Sofianty Kami[1], Syifa Fajar Maulani[2], Melia Handayani[3]

[1],[2],[3] Marine Logistics Study Program, Indonesia University of Education, Indonesia.

Corresponding author : syifa.fajar@upi.edu

Abstract

Orders for small but essential consumables such as packaging material are often split among suppliers without explicit rules for price, quality, delivery, minimum order quantity (MOQ) and mandatory use of all approved suppliers. This study aims to allocate orders of two packing tape variants among three suppliers in an agribusiness manufacturer. Building on earlier work that links the Analytic Hierarchy Process (AHP) with Goal Programming (GP), it keeps price as a measured goal instead of an AHP score and tests how the all-supplier rule and the MOQ shape the outcome. Four procurement experts supplied pairwise judgements, and a weighted non-preemptive GP model was solved in Excel Solver using real e-bidding prices. Quality (0.475), cost (0.398) and delivery (0.127) were the criteria weights, and Supplier B obtained the highest preference score (0.545). The optimal allocation of 600, 800 and 600 units per variant costs IDR 189,830,000, about 0.9% above lowest-price buying, with a 16% higher preference score. Sensitivity tests show that the MOQ, not price or ceiling changes, is the main lever. The study offers a transparent allocation procedure and evidence on what the all-supplier rule costs.

Keywords:Order allocation, Analytic Hierarchy Process, Goal Programming, Multi-sourcing, Packaging procurement.

INTRODUCTION

A steady supply chain in manufacturing depends on more than the main raw materials. Small consumables such as packaging material can interrupt operations when they run short, because products must stay protected while they are handled and distributed (Chopra & Meindl, 2016). Procurement links what a company needs internally with what the supply market can offer, and the way suppliers are chosen and used shapes

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

International Journal of Economics, Business and Innovation Research
https://e-journal.citakonsultindo.or.id/index.php/IJEBIR
E-ISSN : 2964-0865
IJEBIR

cost, quality and continuity of supply (Farrington & Lysons, 2020). Purchases of such items therefore deserve the same discipline as those of strategic inputs.

This study looks at PT X, an integrated palm-oil processing and agribusiness manufacturer. One of its packaging consumables is a 2.5-inch × 400 m packing tape bought in two variants: Smart-Print, which carries a printed logo, and Transparent, which is plain. Suppliers submit offers through an electronic bidding (e-bidding) system, and the company applies a multi-sourcing policy under which all participating suppliers receive part of the order. Choosing the winners is thus only half of the decision; the buyer must also decide how many units each supplier receives.

The bids in Table 1 show why this is not trivial. No supplier is cheapest for both variants. Supplier B is the lowest bidder for Transparent (IDR 40,000 per piece, PC) yet the highest for Smart-Print (IDR 54,000), while Supplier C shows the opposite pattern. Suppliers A and C also bid above the base price of IDR 41,270 for Transparent. Beyond price, the buyer cares about quality and delivery, and the decision must respect four operational conditions: demand of 2,000 PC per variant, an MOQ of 600 PC for any supplier that receives an order, an allocation ceiling of 1,000 PC per supplier per variant, and the activation of all three suppliers for each variant. The 2,000 PC capacity in the bidding system describes what suppliers offered, whereas the 1,000 PC ceiling is the tender allocation limit applied in the model; the two are kept apart throughout this article.

Table 1. E-bidding data used in the study

Item	Supplier A	Supplier B	Supplier C
Smart-Print bid price (IDR/PC)	53,000	54,000	52,250
Transparent bid price (IDR/PC)	42,800	40,000	43,000
Offered capacity per variant (PC)	2,000	2,000	2,000

Base price: Smart-Print IDR 54,810/PC; Transparent IDR 41,270/PC. Source: PT X e-bidding system, 2026 (supplier names anonymised).

Recent studies have paired the Analytic Hierarchy Process (AHP) with Goal Programming (GP) for supplier selection and order allocation in many settings, including box manufacturing (Nisa et al., 2016), coal supply (Imaduddin & Riksakomara, 2017), PET raw material (Ramonanto & Azlia, 2024), sustainable sourcing (Saputro et al., 2023), low-carbon sourcing (Huang & Vaidyanathan, 2022), multi-period single-product

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

purchasing (Lavanpriya et al., 2022) and green and resilient sourcing (Mohammed et al., 2021). In the sources reviewed here, however, the main emphasis is on extending the criteria set (sustainability, carbon, resilience) or on handling uncertainty with fuzzy logic. Little attention goes to a plain, low-value consumable bought under an MOQ and a rule that every approved supplier must be used. Few of these studies show how the allocation changes when the MOQ or the supplier-use rule is changed, or compare the proposed plan with alternative plans so that the price of a policy becomes visible.

This leaves a practical gap. A buyer facing a narrow, heavily constrained decision, as in the tape case, has no documented way to translate expert judgement and bid prices into quantities, and to say what the all-supplier rule and the MOQ cost or save. The contribution of this article is therefore threefold: price is kept as a measured goal in GP and is not scored in AHP, so it is not counted twice; the cost and preference targets come from preliminary optimisation models rather than assumptions; and the supplier-use rule and the MOQ are examined through scenario and sensitivity analysis

Objectives

The article sets out

To determine the weights of cost, quality and delivery from expert judgement;

To derive the priority of each supplier on quality and delivery and combine them into a composite preference score;

To formulate a GP model that yields a feasible order allocation for the two tape variants; and

To test how the allocation behaves under alternative supplier-use rules, MOQ levels, price changes and a larger allocation ceiling, and so to show what the all-supplier rule costs

LITERATURE REVIEW

Procurement practice and supplier evaluation

Procurement is now treated as a strategic function that supports the wider supply chain by balancing cost, quality, delivery and risk (Chopra & Meindl, 2016; Farrington & Lysons, 2020). Within it, supplier evaluation must weigh criteria that often pull in different directions. Quality is read as the ability to meet specification, and delivery as the ability to supply the right quantity on schedule (Monczka et al., 2020). Reviews of the area agree that the problem is a multi-criteria one, which is why AHP is so widely applied. A recent examp

le is the use of AHP alone to select a vendor for packaging boxes (Shoffiyati et al., 2025). AHP ranks suppliers but does not say how many units each should receive, so a second step is needed when orders have to be split.

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

International Journal of Economics, Business and Innovation Research
https://e-journal.citakonsultindo.or.id/index.php/IJEBIR
E-ISSN : 2964-0865
IJEBIR

Procurement practice and supplier evaluation

The studies in Table 2 show how AHP weights are fed into optimisation models. Earlier Indonesian applications use AHP and GP for a box manufacturer and for coal supply (Nisa et al., 2016; Imaduddin & Riksakomara, 2017), and a recent one allocates PET raw material orders (Ramonanto & Azlia, 2024). International work adds sustainability, carbon and resilience criteria or combines AHP with TOPSIS before allocating orders (Mohammed et al., 2021; Saputro et al., 2023; Huang & Vaidyanathan, 2022), and uses fuzzy variants of AHP and GP to deal with imprecise judgements (Huang & Vaidyanathan, 2022; Lavanpriya et al., 2022). A hybrid multi-criteria and multi-choice GP model has also been applied in a tuna cannery (Desyanti et al., 2026).

Table 2. Recent studies on AHP-based order allocation and the position of this study

Study	Methods	Focus or setting
Nisa et al. (2016)	AHP, GP	Supplier selection and order allocation, cardboard box manufacturer
Imaduddin & Riksakomara (2017)	AHP, GP	Supplier selection and coal supply allocation for a power plant
Mohammed et al. (2021)	AHP, TOPSIS, multi-objective programming	Green and resilience criteria in order allocation
Huang & Vaidyanathan (2022)	Fuzzy AHP, fuzzy GP	Low-carbon supplier selection and order quota allocation
Lavanpriya et al. (2022)	Fuzzy AHP, Archimedean GP	Multi-period purchasing of single products
Saputro et al. (2023)	AHP-TOPSIS, GP	Sustainable supplier selection and order allocation over three periods
Ramonanto & Azlia (2024)	AHP, GP	Order allocation of PET raw material
Desyanti et al. (2026)	MCDM, multi-choice GP	Supplier selection and order allocation in a tuna cannery
This study	**AHP, weighted non-preemptive GP**	**Packing tape consumable under MOQ and all-supplier rule; price**

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

International Journal of Economics, Business and Innovation Research
https://e-journal.citakonsultindo.or.id/index.php/IJEBIR
E-ISSN : 2964-0865
IJEBIR

		kept outside AHP; scenario and MOQ sensitivity analysis

Source: compiled by the authors from the cited studies.

Research position

Taken together, recent work has deepened the criteria set and the treatment of uncertainty. This study takes a different and narrower position. It does not add criteria or fuzziness; it examines a small, constrained purchase in which the room for optimisation is limited, and it asks what the operating rules (the MOQ and the all-supplier policy) do to the result. The aim is not to claim the first combination of AHP and GP, but to document a transparent procedure for a case type that the reviewed literature touches only lightly.

RESEARCH METHOD

Research approach

The study is a quantitative, prescriptive case study of one firm. It builds a decision model in two stages: AHP derives criteria weights and supplier priorities from expert judgement, and GP converts these priorities and the actual bid prices into order quantities.

Types and sources of data

Two types of data were used. Primary data are expert pairwise judgements on the Saaty scale of 1 to 9. Secondary data are quantitative parameters of the purchase: bid prices, base prices, offered capacity, demand, the MOQ and the allocation ceiling. Observation notes from the procurement function supported the understanding of the process but were not used as model input. The primary data came from the packaging procurement function of PT X. The secondary data were taken from the company's e-bidding system and internal procurement documents for the study period, with the three suppliers anonymised as A, B and C.

Respondents and instrument

Respondents were chosen deliberately, not at random, because the judgements require direct experience of procurement and supplier evaluation. Four internal experts took part: one Packaging Manager and three Packaging Category Analysts. The instrument was a pairwise-comparison questionnaire with nine questions: three comparing the criteria, three comparing the suppliers on quality and three comparing them on delivery. Cost is not compared among suppliers because it is read directly from

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

International Journal of Economics, Business and Innovation Research
https://e-journal.citakonsultindo.or.id/index.php/IJEBIR
E-ISSN : 2964-0865
IJEBIR

the bids. Before use, the questionnaire was checked for content by a validator with a validation sheet covering instructions, content, construction and language.

Data collection techniques

Data were collected through three techniques: direct and participatory observation of the procurement process, documentation of bid and demand records, and the pairwise-comparison questionnaire. No separate interviews were conducted; the experts' judgements were obtained entirely through the questionnaire.

Theoretical framework

The framework in Figure 1 follows the logic of supply chain management, in which procurement and supplier evaluation are treated as a multi-criteria problem (Chopra & Meindl, 2016; Farrington & Lysons, 2020). AHP captures the subjective judgement on quality and delivery and yields the criteria weights, and GP turns the resulting preference scores and the measured cost into an allocation. Table 3 shows how each criterion enters the model.

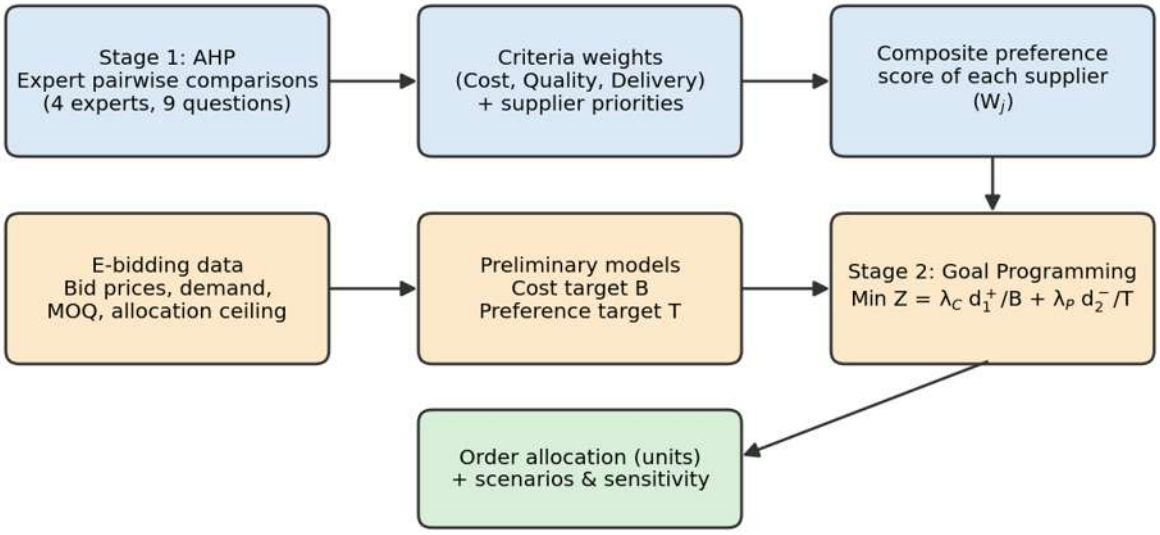


Figure 1. Research framework

Table 3. Role of each criterion in the model

Criterion	How it is measured	Where it enters
Cost	Actual bid price (IDR/PC)	Cost goal in GP; its weight comes from AHP

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

International Journal of Economics, Business and Innovation Research
https://e-journal.citakonsultindo.or.id/index.php/IJEBIR
E-ISSN : 2964-0865
IJEBIR

Quality	Expert pairwise comparison of suppliers	Composite preference score (preference goal)
Delivery	Expert pairwise comparison of suppliers	Composite preference score (preference goal)

Data analysis: AHP

The judgements of the four experts were merged for every pair with the geometric mean, as in Equation (1), where K is the number of experts (Aczél & Saaty, 1983; Forman & Peniwati, 1998). Priorities were obtained by normalising each column of the aggregated matrix and averaging across rows (Saaty, 1980). Consistency was checked with CI = $(\lambda_{max} - n)/(n - 1)$ and CR = CI/RI, using RI = 0.58 for a 3 × 3 matrix. A CR up to 0.10 is normally accepted, and a stricter limit of 0.05 is sometimes applied to matrices of this size (Alonso & Lamata, 2006); both limits were checked.

$$a_{ij} = (a_{ij}^{(1)} \times a_{ij}^{(2)} \times \dots \times a_{ij}^{(K)})^{1/K} \qquad (1)$$

Because cost is read directly from the bids, only quality and delivery are scored for suppliers. Their weights are rescaled to sum to one and combined with the supplier priorities into the composite preference score of supplier j (Equation 2), where w_Q and w_D are the AHP weights of quality and delivery and s_{Qj} and s_{Dj} the local priorities of the supplier.

$$W_j = (w_Q s_{Qj} + w_D s_{Dj}) / (w_Q + w_D) \qquad (2)$$

Data analysis: Goal Programming

Let X_{ij} be the number of units of variant i bought from supplier j, and Y_{ij} a binary variable that equals one when the supplier is used. C_{ij} is the bid price, D_i the demand (2,000 PC), m the MOQ (600 PC), S_{ij} the allocation ceiling (1,000 PC) and W_j the composite preference score. In the weighted, non-preemptive form of GP (Charnes & Cooper, 1957; Ignizio, 1976), all goals are traded off in one objective function. Two targets are needed. The cost target B is the lowest total cost that satisfies all hard constraints, and the preference target T is the highest total preference that satisfies them; each was found by a separate preliminary model. The two goals are expressed through deviation variables, with d_1^+ the overspend above B and d_2^- the shortfall below T:

$$\text{Min } Z = \lambda_C (d_1^+ / B) + \lambda_P (d_2^- / T) \qquad (3)$$

$$\Sigma_i \Sigma_j C_{ij} X_{ij} + d_1^- - d_1^+ = B \qquad (4)$$

$$\Sigma_i \Sigma_j W_j X_{ij} + d_2^- - d_2^+ = T \qquad (5)$$

The hard constraints require each variant to meet its demand, $\Sigma_j X_{ij} = D_i$ (6); every supplier that is used to receive at least the MOQ and at most the ceiling, $m Y_{ij} \le X_{ij} \le S_{ij} Y_{ij}$ (7); and all three suppliers to be active for each variant, $\Sigma_j Y_{ij} \ge 3$ (8). The quantities X_{ij}

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

are non-negative integers. The objective weights are $\lambda_C = w_C$, the AHP weight of cost, and $\lambda_P = w_Q + w_D$, the combined weight of quality and delivery. Dividing each deviation by its target puts the two goals on a comparable scale. The model was solved with the Simplex LP method of Excel Solver with integer and binary restrictions.

Scenarios and sensitivity analysis

Four scenarios were compared: (i) lowest price only, (ii) highest preference only, (iii) at least two active suppliers and (iv) all suppliers active, which is the proposed model. Sensitivity tests then varied the allocation ceiling (1,000 to 1,300 PC), the MOQ (400, 500, 600 and 650 PC), the bid price of each supplier (±5%) and the weight given to cost. Targets B and T were recalculated in each test.

Data credibility

Credibility was supported in several ways. The respondents were experts directly involved in procurement, and the questionnaire was content-validated before use. The consistency ratio of every matrix was checked against the 0.10 and 0.05 limits, which is the reliability check appropriate to pairwise-comparison data. The secondary data come from actual company records and were verified through observation. The targets were produced by preliminary models, so they are attainable, and the scenario and sensitivity analyses test how far the result depends on the assumptions.

RESULT

Criteria Weights

Table 4 shows the aggregated judgements and the resulting weights. The experts rated cost and quality as equally important (geometric mean 1.000) and both as more important than delivery (2.632 and 4.527). Quality therefore received the largest weight (0.475), followed by cost (0.398) and delivery (0.127). The matrix was consistent (λ_{max} = 3.033, CI = 0.016, CR = 0.028), below both the 0.10 and the 0.05 limits.

Table 4. Aggregated criteria comparison and weights

Criterion	Cost	Quality	Delivery	Weight
Cost	1.000	1.000	2.632	0.398
Quality	1.000	1.000	4.527	0.475
Delivery	0.380	0.221	1.000	0.127

Source: data processed by the authors, 2026. CR = 0.028.

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

International Journal of Economics, Business and Innovation Research
https://e-journal.citakonsultindo.or.id/index.php/IJEBIR
E-ISSN : 2964-0865
IJEBIR

Supplier priorities

Table 5 gives the supplier priorities. On quality, Supplier B leads clearly (0.591), with Suppliers C and A far behind (0.216 and 0.193); the matrix had CR = 0.012. On delivery the three suppliers are close, with B slightly ahead (0.372), then A (0.332) and C (0.296), again with CR = 0.012. Combining the two with Equation (2) gives composite scores of 0.222 for A, 0.545 for B and 0.233 for C.

Table 5. Supplier priorities and composite preference scores

Supplier	Quality (w = 0.475)	Delivery (w = 0.127)	Composite score W_j
A	0.193	0.332	0.222
B	0.591	0.372	0.545
C	0.216	0.296	0.233

Source: data processed by the authors, 2026.

Targets and optimal allocation

The preliminary cost model, which puts the free units on the cheapest bidder of each variant, gave B = IDR 189,480,000 (Smart-Print 106,000,000; Transparent 83,480,000). The preliminary preference model gave T = 1,418. Without the all-supplier rule the preference could rise to 1,556, but only by leaving Supplier A unused.

Solving Equations (3) to (8) produced the allocation in Table 6: 600 units for Supplier A, 800 for Supplier B and 600 for Supplier C, for both variants. The total cost is IDR 189,830,000, which is IDR 350,000 (0.18%) above the cost target, and the preference score reaches the target of 1,418, so that $d_2^- = 0$. The objective value is about 0.0007.

Table 6. Optimal order allocation

Variant	Supplier	Bid price (IDR/PC)	Units (PC)	Cost (IDR)
Smart-Print	A	53,000	600	31,800,000
	B	54,000	800	43,200,000
	C	52,250	600	31,350,000
Transparent	A	42,800	600	25,680,000
	B	40,000	800	32,000,000
	C	43,000	600	25,800,000

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

International Journal of Economics, Business and Innovation Research
https://e-journal.citakonsultindo.or.id/index.php/IJEBIR
E-ISSN : 2964-0865
IJEBIR

Total			**4,000**	**189,830,000**

Source: data processed by the authors, 2026.

Comparison of scenarios

Table 7 and Figure 2 compare the four scenarios. Relative to the lowest-price allocation, the proposed model costs IDR 1,780,000 more (about 0.9%) and raises the preference score by 16% (1,418 against 1,222). The two scenarios that are free to leave a supplier unused are both slightly cheaper than the proposed allocation and score higher on preference: the preference-only scenario costs IDR 580,000 less and scores 1,556, and the two-supplier scenario costs IDR 30,000 less and scores 1,534. The proposed plan's preference score is thus 7.6% to 8.9% below those two scenarios.

Table 7. Scenario comparison

Scenario	Units to A / B / C (per variant)	Total cost (IDR)	Preference	Active suppliers
Lowest price only	Smart-Print 1,000/0/1,000; Transparent 1,000/1,000/0	188,050,000	1,222	2
Preference only	0 / 1,000 / 1,000	189,250,000	1,556	2
At least two suppliers	1,000 / 1,000 / 0	189,800,000	1,534	2
All suppliers (proposed)	600 / 800 / 600	189,830,000	1,418	3

Source: data processed by the authors, 2026.

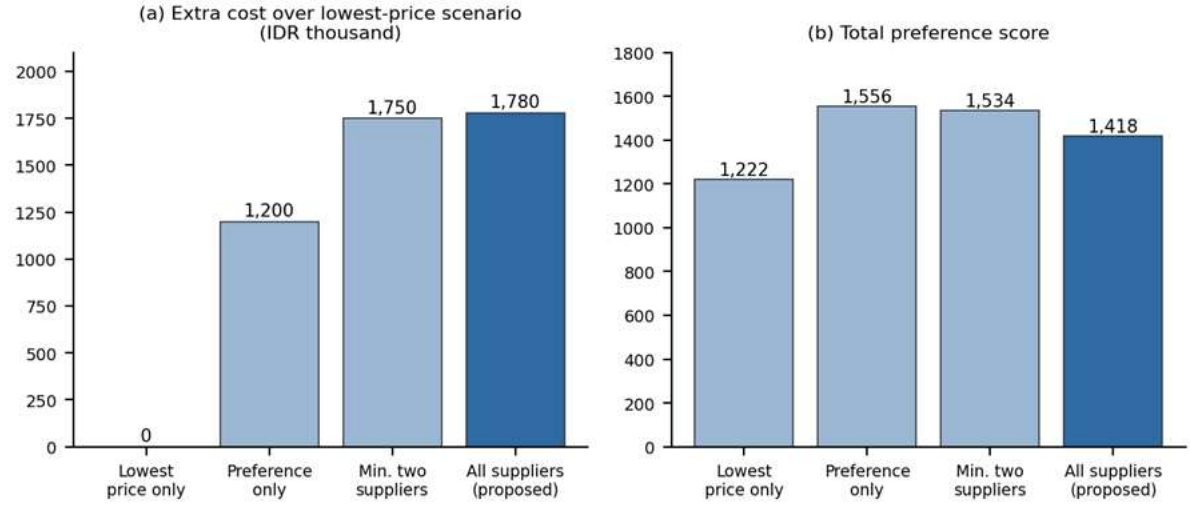


Figure 2. Extra cost and preference score by scenario

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

International Journal of Economics, Business and Innovation Research
https://e-journal.citakonsultindo.or.id/index.php/IJEBIR
E-ISSN : 2964-0865
IJEBIR

Sensitivity analysis

Raising the allocation ceiling from 1,000 to 1,300 PC did not change the result. Changing the price of any single supplier by ±5% moved the total cost between IDR 186.07 million and IDR 193.59 million, but the allocation stayed at 600/800/600. The MOQ, by contrast, changed the result (Table 8). At an MOQ of 500 PC, Supplier B reaches its ceiling of 1,000 PC, the cost falls by IDR 305,000 and the preference score rises by about 9%. An MOQ of 400 PC lowers the cost a little further and raises preference to 1,547, while an MOQ of 650 PC raises the cost and lowers preference to about 1,355. The allocation shifted with the weight of cost only when that weight was raised to about 0.96.

Table 8. Sensitivity of the allocation to the MOQ

MOQ (PC)	Units A / B / C (per variant)	Total cost (IDR)	Preference	Change vs MOQ 600
400	400 / 1,000 / 600	189,470,000	1,547	Cost −0.19%; pref. +9.1%
500	500 / 1,000 / 500	189,525,000	1,545	Cost −0.16%; pref. +9.0%
600 (base)	600 / 800 / 600	189,830,000	1,418	–
650	650 / 700 / 650	189,982,500	1,355	Cost +0.08%; pref. −4.5%

Source: data processed by the authors, 2026.

DISCUSSION

Criteria, suppliers and the nature of the trade-off

The weights place quality and cost far above delivery, which agrees with the view in supplier-evaluation reviews that cost, quality and delivery are the core criteria (Ho et al., 2010), and shows that the experts see delivery as the least decisive of the three for this item. Supplier B is the preferred supplier on non-price grounds but is the most expensive for Smart-Print, so the case contains a genuine conflict between price and preference. This conflict is what GP resolves, and it is the reason why a price-only ranking would misrepresent the buyer's priorities.

Why the optimum looks the way it does

The result follows from the structure of the problem. Three MOQs of 600 PC take up 1,800 of the 2,000 PC, so only 200 PC per variant can be moved freely. For Transparent, Supplier B is both the cheapest bidder and the most preferred supplier, so it takes the 200 PC without any conflict. The real trade-off appears for Smart-Print: placing

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

the 200 PC with Supplier C instead of B would save IDR 350,000 (0.18% of the cost target) but would lower the preference score by 62.4 points (4.4% of the target). Given the weights in Equation (3), the model keeps the units with Supplier B. The stability of the allocation under price and ceiling changes is partly mechanical for the same reason, since the room to move is small. The weak influence of the cost weight also needs care. Because each deviation is divided by its own target, a cost deviation of 0.18% is compared with a preference deviation of 4.4%, and cost is almost bound to lose. This reflects the normalisation as much as the experts' view; a normalisation based on the range between the best and worst feasible values would give cost more influence and is worth testing.

The price of the all-supplier rule

Multi-sourcing is usually justified as a way to reduce supply risk and to keep alternatives open when a supplier fails (Tang, 2006; Sheffi & Rice, 2005). The scenarios put a number on its cost in this case. Against lowest-price buying the all-supplier plan is only about 0.9% dearer and scores 16% higher on preference. Against plans that may leave a supplier unused, however, it is a little dearer and scores 7.6% to 8.9% lower. The price of the rule therefore shows up mainly as lost preference and not as extra spending. The resilience benefit that the rule is meant to buy was not measured here, and the company should weigh it separately. Compared with the recent studies in Table 2, which concentrate on richer criteria or fuzzy inputs, this is the new element: an explicit statement of what an operating rule costs.

The MOQ as the main lever

The MOQ proved to be the lever that matters most. Lowering it from 600 to 500 PC lets more volume reach the preferred supplier, lowers the cost by IDR 305,000 and raises preference by about 9%, whereas price and ceiling changes left the allocation unchanged. This points to a concrete managerial action: negotiating a lower MOQ with Suppliers A and C. The finding assumes that bid prices would stay the same when the MOQ changes, which may not hold in practice, so it is best used as a basis for negotiation. For the buyer, the model also offers a repeatable way to document why units are split as they are, and it can be rerun at every bidding round.

Limitations

Several limits should be kept in mind. The expert panel has four members and judges quality and delivery from perception, not from recorded reject or on-time rates. AHP priorities are relative among the three suppliers, so a score of 0.545 against 0.222 does not mean that one supplier performs 2.5 times better in absolute terms. The model

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

is deterministic and covers one product and one bidding period. Finally, the company's actual allocation was not available as a benchmark, so the improvements reported here are relative to the constructed scenarios.

CONCLUSION

This article combined AHP and weighted Goal Programming to allocate orders for two packing tape variants among three suppliers under demand, MOQ, ceiling and all-supplier constraints. Expert judgement placed quality (0.475) ahead of cost (0.398) and delivery (0.127), and made Supplier B the most preferred supplier (0.545). The optimal plan assigns 600, 800 and 600 units to Suppliers A, B and C for each variant, at IDR 189,830,000 and a preference score of 1,418. Compared with buying at the lowest price, the plan costs about 0.9% more but scores 16% higher on preference. Compared with plans that may leave a supplier unused, it is almost as cheap but scores lower on preference, which is the practical cost of using all suppliers. The allocation proved stable against price changes of ±5% and a larger ceiling, and was sensitive mainly to the MOQ.

The results can help procurement teams record and defend allocation decisions and can support negotiations on the MOQ. The study is limited by its small expert panel, perception-based scoring, deterministic data and single case. Future work could use objective supplier performance data, test range-based normalisation of the goals, include uncertainty in prices and demand, and quantify the supply-security benefit of multi-sourcing so that it can be set against the preference loss reported here.

Note: this article is derived from the first author's undergraduate thesis at Universitas Pendidikan Indonesia, Serang Regional Campus

REFERENCES

Aczél, J., & Saaty, T. L. (1983). Procedures for synthesizing ratio judgements. *Journal of Mathematical Psychology*, *27*(1), 93–102. https://doi.org/10.1016/0022-2496(83)90028-7

Alonso, J., & Lamata, M. (2006). Consistency in the analytic hierarchy process: A new approach. International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems, 14, 445–459. https://doi.org/10.1142/S0218488506004114

Charnes, A., & Cooper, W. W. (1957). Management models and industrial applications of linear programming. Management Science, 4(1), 38–91. http://www.jstor.org/stable/2627263

Chopra, S., & Meindl, P. (2016). Supply chain management: Strategy, planning, and operation. Pearson.

Desyanti, R., Suparno, & Arvitrida, N. I. (2026). Optimizing supplier selection and order allocation in a tuna cannery: A hybrid MCDM and MCGP approach. IOP

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Conference Series: Earth and Environmental Science, 1650(1), 012007. https://doi.org/10.1088/1755-1315/1650/1/012007

Farrington, B., & Lysons, K. (2020). Procurement and supply chain management. Pearson.

Forman, E., & Peniwati, K. (1998). Aggregating individual judgments and priorities with the analytic hierarchy process. European Journal of Operational Research, 108(1), 165–169. https://doi.org/10.1016/S0377-2217(97)00244-0

Ho, W., Xu, X., & Dey, P. K. (2010). Multi-criteria decision making approaches for supplier evaluation and selection: A literature review. European Journal of Operational Research, 202(1), 16–24. https://doi.org/10.1016/j.ejor.2009.05.009

Huang, F., & Vaidyanathan, S. (2022). Low-carbon supplier selection using fuzzy AHP and goal programming approach. Discrete Dynamics in Nature and Society, 2022, Article 3115490. https://doi.org/10.1155/2022/3115490

Ignizio, J. P. (1976). Goal programming and extensions. Lexington Books.

Imaduddin, M. A., & Riksakomara, E. (2017). Optimasi pemilihan supplier dan alokasi supply batubara pada PLTU kapasitas 615MW dengan menggunakan metode analytical hierarchy process dan goal programming (studi kasus PT. XYZ). Jurnal Teknik ITS, 6.

Lavanpriya, C., Muthukumaran, V., Manoj Kumar, P., & Seikh, M. R. (2022). Evaluating suppliers using AHP in a fuzzy environment and allocating order quantities to each supplier in a supply chain. Mathematical Problems in Engineering, 2022, Article 8695983. https://doi.org/10.1155/2022/8695983

Mohammed, A., Harris, I., Soroka, A., Naim, M., Ramjaun, T., & Yazdani, M. (2021). Gresilient supplier assessment and order allocation planning. Annals of Operations Research, 296, 335–362. https://doi.org/10.1007/s10479-020-03611-x

Monczka, R. M., Handfield, R. B., Giunipero, L. C., & Patterson, J. L. (2020). Purchasing and supply chain management. Cengage Learning.

Nisa, F. K., Sumantri, Y., & Azlia, W. (2016). Pemilihan pemasok dan pengalokasian order dengan menggunakan metode analytical hierarchy process dan goal programming (studi kasus: CV Sinar Jaya Box, Pasuruan). Jurnal Rekayasa dan Manajemen Sistem Industri, 4(7), 1–11.

Ramonanto, A. S., & Azlia, W. (2024). Optimisasi alokasi pemesanan bahan baku PET terhadap pemasok melalui metode AHP dan goal programming (studi kasus: PT Alam Lestari Lancar). Jurnal Rekayasa Sistem dan Manajemen Industri, 1(4), 458–465. https://doi.org/10.21776/ub.jrsmi.2024.01.04.08

Saaty, T. L. (1980). The analytic hierarchy process: Planning, priority setting, resource allocation. McGraw-Hill.

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.

Saputro, T. E., Khusna, Z. H. A. M., & Dewi, S. K. (2023). Sustainable supplier selection and order allocation using integrating AHP-TOPSIS and goal programming. Jurnal Teknik Industri, 24(2), 141–156.

Sheffi, Y., & Rice, J. B. (2005). A supply chain view of the resilient enterprise. MIT Sloan Management Review, 47(1), 41–48.

Shoffiyati, P., Kristianto, F., & Ramadan, P. (2025). Vendor selection for the main packaging box using the analytical hierarchy process (AHP) method. Nativa, 13(4), 612–620. https://doi.org/10.31413/nat.v13i4.19723

Tang, C. S. (2006). Perspectives in supply chain risk management. International Journal of Production Economics, 103(2), 451–488.

Copyright at authors some right reserved this work is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.