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Mapping Purchasing Item to Improve Procurement Process on Smelter Project at PT. X

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ABSTRACT

The procurement process in large-scale projects such as smelter construction is key in ensuring the overall success of the project, especially in the context of cost, time, and quality. The main problem that occurs at PT X is the occurrence of significant cost overruns caused by inefficiencies in the procurement process, such as errors in planning needs, delays in delivery, and mismatches in item specifications. This study aims to map purchasing items using the Kraljic Matrix based on supply risk and profit impact to develop a more strategic procurement approach. This research uses a quantitative approach with a survey method to procurement employees at PT X. As for mapping PT X's purchasing items, material classification will be carried out based on the Kraljic Matrix to identify strategic items. By classifying items into four categories—non-critical, leverage, bottleneck, and strategic—the company can apply differentiated procurement tactics for better risk and cost control.

KEYWORDS

Strategic Procurement, Kraljic Matrix, Procurement Process, Smelter Project, Cost Overrun

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1. INTRODUCTION

The procurement process is one of the key factors in the success of large-scale construction projects, including the construction of the Smelter Project at PT X. However, in its implementation, the procurement process at PT X experienced significant inefficiencies, characterized by a cost overrun of 71.08% of the initial budget that happened because of errors in planning needs, delays in delivery, and mismatches in item specifications. On the other hand, at PT X, material classification system is still not used so all materials are treated using a uniform procurement approach. In fact, the characteristics of each material ideally require different procurement strategies to optimize resource allocation and minimize risk.

As a solution to this problem, the Kraljic Matrix is adopted as a strategic framework in mapping purchasing items. This matrix classifies items based on two main dimensions, namely the level of supply risk and its impact on the company's bottom line. Based on the combination of these two dimensions, items are categorized into four quadrants: non-critical items, leverage items, bottleneck items, and strategic items, each of which demands a different procurement management approach. Through mapping using the Kraljic Matrix, companies can prioritize item management, strengthen procurement strategies, and improve supply chain efficiency.

A number of previous studies have shown that the implementation of the Kraljic Matrix in material mapping can have a positive impact on procurement performance. Research conducted at PT Semen Padang, for example, showed that item classification using the Kraljic Matrix supported contract adjustments and more effective and focused supplier relationship management. These findings strengthen the argument that mapping purchasing items based on risk and business impact can improve the overall procurement process (Wirdianto et al., 2024).

Based on this background, this research aims to map purchasing items at PT X using the Kraljic Matrix to identify strategic items. By identifying strategic item, risk can be minimalized and profit can be maximized while processing the procurement for all materials in strategic item.

2. LITERATURE REVIEW

2.1 Spend Analysis

Spend analysis is the examination of historical spending patterns within an organization, typically categorized by commodities or procurement categories. This process serves as the foundation of strategic procurement management, as it allows companies to clearly understand how, to whom, and for what purposes funds have been spent (Pandit & Marmanis, 2008).

Spend analysis is generally conducted in three main stages: data collection, data cleansing and classification, and data analysis. The first stage involves integrating data from various sources, such as ERP systems, invoices, and purchase records. The second stage ensures data consistency and accuracy by eliminating duplicates, classifying purchases by category (e.g., commodity, supplier, department), and aligning different terms for the same entities. The third stage is the analysis phase, in which the information is used to identify spending trends, supplier concentration, potential savings, and risk areas (Marzic et al., 2014).

The primary benefits of spend analysis include improved spending transparency, enhanced bargaining power with suppliers, and a strong foundation for strategic procurement decision-making. By grouping expenditures into accurate categories, companies can consolidate purchasing volumes to obtain discounts, evaluate supplier performance, and reduce off-contract or "maverick" spending (Thai, 2017).

In addition, spend analysis serves as the basis for implementing strategic sourcing—a more proactive and data-driven procurement approach. Companies that successfully implement in-depth spend analysis can develop long-term purchasing strategies, conduct data-driven negotiations, and build long-term relationships with strategic suppliers. In several case studies, the application of spend analysis has even resulted in annual savings of millions of dollars (Thai, 2017; Pandit & Marmanis, 2008).

2.2 Kraljic Matrix

According to Gelderman (2003), a portfolio can be understood as a collection of various items, objects, or subjects that are interconnected. This concept provides companies with opportunities to differentiate and distribute strategies in an effort to balance and optimize the utilization of available resources. The portfolio approach is also used as a tool to examine and address managerial problems by focusing attention on the most relevant and significant aspects (Gelderman, 2003, p. 21).

The Kraljic's Portfolio Matrix is one of the strategic analytical tools in procurement management, developed by Peter Kraljic in 1983. This model aims to help companies manage purchasing activities in a more targeted and strategic manner by mapping various types of materials or goods based on two main dimensions: supply risk and profit impact. The primary goal of this model is to make procurement an integral part of business strategy, rather than merely an operational and transactional function (Handayani, 2017).

Kraljic's Portfolio Matrix is built upon two main dimensions: Profit Impact and Supply Risk. These two dimensions are used to classify goods or services into four quadrants of the matrix, which then serve as the basis for determining the appropriate procurement strategy.

1. Profit Impact: This dimension indicates how much influence a particular item has on the company's financial performance. The greater an item's contribution to revenue, cost, or operational continuity, the higher its profit impact. Criteria used to assess profit impact include purchase value (monetary value or high volume), impact on the quality of final products, influence on company revenue or profit, contribution to competitive advantage, and effect on production or operational processes.
2. Supply Risk: This dimension reflects the level of difficulty or uncertainty in acquiring the goods or services from the market, due to supplier scarcity, market conditions, or technical complexity. Criteria for assessing supply risk include the number of available suppliers (monopoly vs. competitive market), stability or uncertainty of supply, technical complexity of the product or service, market entry barriers for new suppliers, dependency on a single supplier or specific location, and logistical or political risks.

The combination of these two dimensions forms the four main quadrants in the Kraljic Matrix: Non-Critical, Leverage, Bottleneck, and Strategic, as illustrated in Figure 2.6 below.

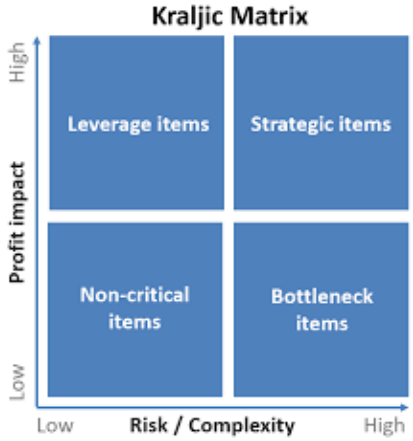

Figure 1: Kraljic Matrix Concept
Source: Kraljic, 1983

The non-critical quadrant includes items with low profit impact and low supply risk. These are typically everyday operational goods that are easy to procure, widely available, and do not significantly affect profits or production. The Leverage quadrant covers items with high profit impact but low supply risk. These items are high in value or volume, have many competitive suppliers, and greatly influence cost or quality.

Items in the Bottleneck quadrant are those with high supply risk but low profit impact. They are typically hard to source, with limited suppliers, not very impactful to profit, but can disrupt operations if unavailable. These items are often technically complex or highly specialized. Finally, items in the Strategic quadrant have both high profit impact and high supply risk. These are critical to business continuity, hard to replace, have few suppliers, and offer competitive advantage.

To optimize procurement, each item category requires a tailored strategy. For non-critical items: simplify procurement processes, reduce administrative costs, and implement automation or e-procurement. For Leverage items: conduct aggressive price negotiations, consolidate purchase volumes, and use auctions or tenders. For Bottleneck items: maintain good supplier relationships, build buffer stocks, and explore technical alternatives or substitutions. For Strategic items: establish long-term partnerships, engage in joint innovation and development, and apply proactive risk management.

3. METHODOLOGY

3.1 Purchasing Item of PT X

The material of this study is the purchasing items of PT X Smelter Project during 2022-2024 which comes from the procurement report of PT X. The Purchasing item PT X Smelter Project during 2022-2024 consist of 10.318 Purchase Orders (PO), 14.764 items, 53 Categories, 187 Sub Categories and 674 Supplier. Total of Purchasing Price is US$ 664.138.310. The Purchasing Item classification code at PT X is based on The NATO Codification System (NCS) where each item code consists of 12 numbers. The NATO Codification System (NCS) is an international system developed to classify, identify, and manage goods or materiel. This system aims to standardize the classification of items. The following is the standardization of item classification by NATO (Facsheet The NATO Codification System, 1949)

Table 1 Purchasing Items at PT X for Smelter Project Period 2022-2024

No	Item Code	Category	Purchasing Price (US$)	Number of Supplier
1	23	Land Effect Vehicles, Motor Vehicles, Trailers and Motorcycles	74.855	1

No	Item Code	Category	Purchasing Price (US$)	Number of Supplier
2	25	Vehicle Parts	1.604.394	35
3	26	Wheels, Tires	71.716	17
4	29	Machine Accessories	2.357.581	50
5	30	Mechanical Power Transmission Equipment	1.393.481	56
6	31	Bearing	2.321.412	24
7	32	Woodworking Machinery and Equipment	13.566	6
8	34	Metal Cutting Machine	1.932.723	38
9	35	Site Service Equipment	543.897	30
10	37	Agricultural Machinery and Equipment	535.642	8
11	38	Construction, Mining, Quarrying and Highway Maintenance Equipment	237.751	14
12	39	Material Handling Equipment	2.361.397	38
13	40	Ropes, Cables, Chains, and Attachments	615.188	33
14	41	Refrigeration, Air Conditioning and Air Circulation Equipment	999.911	31
15	42	Fire Fighting, Rescue and Safety Equipment; and Environmental Protection Equipment and Materials	1.304.405	46
16	43	Pumps and Compressors	1.594.254	46
17	44	Furnaces, Steam Generators, and Drying Equipment; and Nuclear Reactors	1.624.297	16
18	45	Piping, Heating and Sewage Disposal Equipment	2.235.767	19
19	46	Water Purification and Sewage Treatment Equipment	2.408	1
20	47	Pipes, Tubes, Hoses, and Fittings	14.293.461	127
21	48	Valves	3.398.380	76
22	49	Maintenance and Repair Workshop Equipment	3.855.843	51
23	51	Hand Tools	1.405.741	74
24	52	Measuring Instruments	180.747	28
25	53	Abrasive Hardware and Materials	5.146.959	169
26	54	Prefabricated Structures and Scaffolding	34.471	4
27	55	Wood, Wood Processing, Plywood and Veneer	357.440	7
28	56	Construction and Building Materials	36.224.172	84
29	58	Coherent Communication, Detection and Radiation Equipment	231.313	20
30	59	Capacitors	9.506.045	94
31	61	Power Cables, Power and Distribution Equipment	5.199.574	84
32	62	Lighting and Lighting Fixtures	542.688	43
33	63	Security Alarm, Signal and Detection Systems	37.120	13
34	65	Medical, Dental and Veterinary Equipment and Supplies	232.770	19
35	66	Laboratory Instruments and Equipment	3.702.864	122
36	67	Photography Equipment	143.456	12
37	68	Chemicals, Gases, and Chemical Products	14.403.864	61
38	70	Automated Data Processing Equipment (Including Firmware), Software, Equipment and Supporting Equipment	1.889.228	31
39	71	Furniture	1.089.098	32
40	72	Mess Equipment and Supplies	2.302.001	23
41	73	Dining Equipment and Supplies	501.810	16

No	Item Code	Category	Purchasing Price (US$)	Number of Supplier
42	74	Office Machine, Text Processing System	1.025	1
43	75	Office Equipment and Supplies	770.236	54
44	76	Books, Maps, and Other Publications	35.492	11
45	78	Recreational and Athletic Equipment	225.783	13
46	79	Cleaning Equipment and Supplies	87.730	27
47	80	Brushes, paints, sealers, and adhesives.	6.852.725	44
48	81	Containers, Packaging, and Packaging Supplies	108.199	24
49	84	Clothing, Individual Equipment, and Emblems	1.889.767	43
50	85	Sanitary	12.935	10
51	91	Fuels, Lubricants, Oils, and Waxes	1.971.903	29
52	95	Bars, Sheets, and Metal Shapes	11.393.120	75
53	99	Equipment, Installation, etc	514.285.708	341

Source: Procurement Report of PT X Smelter Project 2022-2024, (2025)

3.2 The Assessment of Purchasing Item

To asses supply risk and profit impact of each purchasing item, we will give Questionnaire to respondents online. Respondents in this study are employees of the procurement department at PT X who are directly involved in the process of planning, implementing, and evaluating goods and services procurement activities totalling 30 people consisting of 1 General Manager, 2 Senior Managers, 3 Managers, 3 Assistant Managers and 21 Staff. The selection of these respondents is based on the consideration that they have sufficient understanding and experience related to the implementation of procurement strategies and can assess the risk and profit of each purchasing item based on their daily duties and responsibilities. Table 2.2 show purchasing item assessment questionnaire. The result of this Questionnaire will be used to map the purchasing item into Kraljic Matrix.

Table 2 Purchasing Item Assessment Questionnaire

On a scale of 1-10 (1: very low, 10: very high), how would you rate the supply risk and profit impact for each purchasing item?

No	Item code	Purchasing Item	Supply Risk			Profit Impact		
			Market Risk	Performance Risk	Complexity Risk	Impact on Profitability	Critically of Purchase	Cost/value of Purchasing
1	23	Land Effect Vehicles, Motor Vehicles, Trailers and Motorcycles						
2	25	Vehicle Parts						
3	26	Wheels, Tires						
4	29	Machine Accessories						
5	30	Mechanical Power Transmission Equipment						
6	31	Bearing						
7	32	Woodworking Machinery and Equipment						
8	34	Metal Cutting Machine						
9	35	Site Service Equipment						

On a scale of 1-10 (1: very low, 10: very high), how would you rate the supply risk and profit impact for each purchasing item?

No	Item code	Purchasing Item	Supply Risk			Profit Impact		
			Market Risk	Performance Risk	Complexity Risk	Impact on Profitability	Critically of Purchase	Cost/value of Purchasing
10	37	Agricultural Machinery and Equipment						
11	38	Construction, Mining, Quarrying and Highway Maintenance Equipment						
12	39	Material Handling Equipment						
13	40	Ropes, Cables, Chains, and Attachments						
14	41	Refrigeration, Air Conditioning and Air Circulation Equipment						
15	42	Fire Fighting, Rescue and Safety Equipment; and Environmental Protection Equipment and Materials						
16	43	Pumps and Compressors						
17	44	Furnaces, Steam Generators, and Drying Equipment; and Nuclear Reactors						
18	45	Piping, Heating and Sewage Disposal Equipment						
19	46	Water Purification and Sewage Treatment Equipment						
20	47	Pipes, Tubes, Hoses, and Fittings						
21	48	Valves						
22	49	Maintenance and Repair Workshop Equipment						
23	51	Hand Tools						
24	52	Measuring Instruments						
25	53	Abrasive Hardware and Materials						
26	54	Prefabricated Structures and Scaffolding						
27	55	Wood, Wood Processing, Plywood and Veneer						
28	56	Construction and Building Materials						
29	58	Coherent Communication, Detection and Radiation Equipment						
30	59	Capacitors						
31	61	Power Cables, Power and Distribution Equipment						
32	62	Lighting and Lighting Fixtures						
33	63	Security Alarm, Signal and Detection Systems						
34	65	Medical, Dental and Veterinary Equipment and Supplies						
35	66	Laboratory Instruments and Equipment						
36	67	Photography Equipment						
37	68	Chemicals, Gases, and Chemical Products						
38	70	Automated Data Processing Equipment (Including Firmware), Software, Equipment and Supporting Equipment						
39	71	Furniture						
40	72	Mess Equipment and Supplies						
41	73	Dining Equipment and Supplies						

On a scale of 1-10 (1: very low, 10: very high), how would you rate the supply risk and profit impact for each purchasing item?

No	Item code	Purchasing Item	Supply Risk			Profit Impact		
			Market Risk	Performance Risk	Complexity Risk	Impact on Profitability	Critically of Purchase	Cost/value of Purchasing
42	74	Office Machine, Text Processing System						
43	75	Office Equipment and Supplies						
44	76	Books, Maps, and Other Publications						
45	78	Recreational and Athletic Equipment						
46	79	Cleaning Equipment and Supplies						
47	80	Brushes, paints, sealers, and adhesives.						
48	81	Containers, Packaging, and Packaging Supplies						
49	84	Clothing, Individual Equipment, and Emblems						
50	85	Sanitary						
51	91	Fuels, Lubricants, Oils, and Waxes						
52	95	Bars, Sheets, and Metal Shapes						
53	99	Equipment, Installation, etc						

Source: Procurement Report of PT X Smelter Project 2022-2024, (2025)

To determine the relative importance of assessment criteria within the Kraljic Matrix framework, this study employed a structured expert judgment approach. The supply risk dimension was assessed using three sub-factors: market risk, performance risk, and complexity risk. These factors were selected based on their prevalence in procurement literature and their contextual relevance to large-scale industrial projects (Gelderman & Van Weele, 2005; Jaipuria et al., 2016). Market risk reflects the availability and competitiveness of suppliers; performance risk accounts for the likelihood of supplier failure or nonconformity; and complexity risk captures the technical and logistical difficulties in procuring specific items. Similarly, the profit impact dimension was evaluated through three sub-factors: cost/value of purchasing, impact on profitability, and criticality of the item to operations. These criteria collectively capture the financial and strategic weight of procurement decisions on project execution and firm performance (Handayani, 2017; Ulkhaq & Pratiwi, 2024).

To establish the weighting of these factors, a preliminary questionnaire was distributed to three senior procurement practitioners at PT X. The expert panel included one General Manager, one Senior Manager, and one Manager from the Procurement Division, each with more than 10 years of experience in industrial procurement. The experts independently assigned preference scores (on a scale of 1–10) to each factor, which were then averaged and normalized to produce the final weighting. The consensus was reached through a short alignment session, ensuring that the final scores reflected both individual judgment and collective agreement on the strategic relevance of each dimension to PT X's procurement context.

4. RESULTS & DISCUSSION

4.1 Spend Analysis Result

To choose the item that significant to analyse, we use spend Analysis. As mentioned before, spend analysis is the process of analysing an organization's historical spending patterns by category or commodity, which forms the basis of strategic procurement management. The process is conducted through three main stages: data collection from various sources, data cleaning and

classification to ensure accuracy, and analysis of spend trends and identification of efficiency opportunities (Pandit & Marmanis, 2008; Marzic et al., 2014). Spend analysis provides companies with an in-depth understanding of spend streams, supplier concentrations, and potential risk areas, ultimately supporting transparency and improved procurement processes. Key benefits of spend analysis include increased bargaining power with suppliers, reduction of non-contractual spend, and the development of data-driven procurement strategies. Spend analysis also plays an important role in supporting strategic sourcing practices, where procurement is done proactively based on an understanding of historical spend. By implementing effective spend analysis, companies can consolidate purchases to gain cost efficiencies, strengthen relationships with strategic suppliers, and achieve substantial savings in procurement operations (Thai, 2017; Pandit & Marmanis, 2008).

By using the spend analysis method, the 53 purchasing item categories were sorted by purchasing price from largest to smallest so that the purchasing items with the largest to smallest purchase value could be identified. Thus, the purchasing items that will be assessed through the questionnaire are 20 purchasing items with the largest purchase value during 2022-2024. These 20 purchasing items also represent 97% of the total procurement value in the smelter project at PT X (Kamil dan Mulyono, 2025; Thai, 2017; Pandit & Marmanis, 2008). The following is a list of the 20 purchasing items based on spend analysis.

Table 3 Purchasing Item Based on Spend Analysis

No	Item Code	Category	Purchasing Price (US$)	Number of Supplier
1	99	Equipment, Installation, etc	514.285.708	341
2	56	Construction and Building Materials	36.224.172	84
3	68	Chemicals, Gasses, and Chemical Products	14.403.864	61
4	47	Pipes, Tubes, Hoses, and Fittings	14.293.461	127
5	95	Metal Bars, Sheets, and Shapes	11.393.120	75
6	59	Capacitors	9.506.045	94
7	80	Brush, Paint, Sealer, and Adhesive	6.852.725	44
8	61	Electrical Cables, Power and Distribution Equipment	5.199.574	84
9	53	Abrasive Hardware and Materials	5.146.959	169
10	49	Maintenance and Repair Workshop Equipment	3.855.843	51
11	66	Laboratory Instruments and Equipment	3.702.864	122
12	48	Valves	3.398.380	76
13	39	Material Handling Equipment	2.361.397	38
14	29	Machine Accessories	2.357.581	50
15	31	Bearing	2.321.412	24
16	72	Mess Equipment and Supplies	2.302.001	23
17	45	Plumbing, Heating, and Sewage Equipment	2.235.767	19
18	91	Fuels, Lubricants, Oils and Candles	1.971.903	29
19	34	Metal Cutting Machine	1.932.723	38
20	84	Clothing, Individual Equipment, and Insignia	1.889.767	43

Source: Procurement Report of PT X Smelter Project 2022-2024, (2025)

4.2 The Mapping of Purchasing Item Based on Kraljic Matrix

After identifying the Top 20 Purchasing Items to be studied, each of these items will then be evaluated based on the dimensions of supply risk and profit impact in accordance with the Kraljic Matrix framework. The steps of mapping as shown as below:

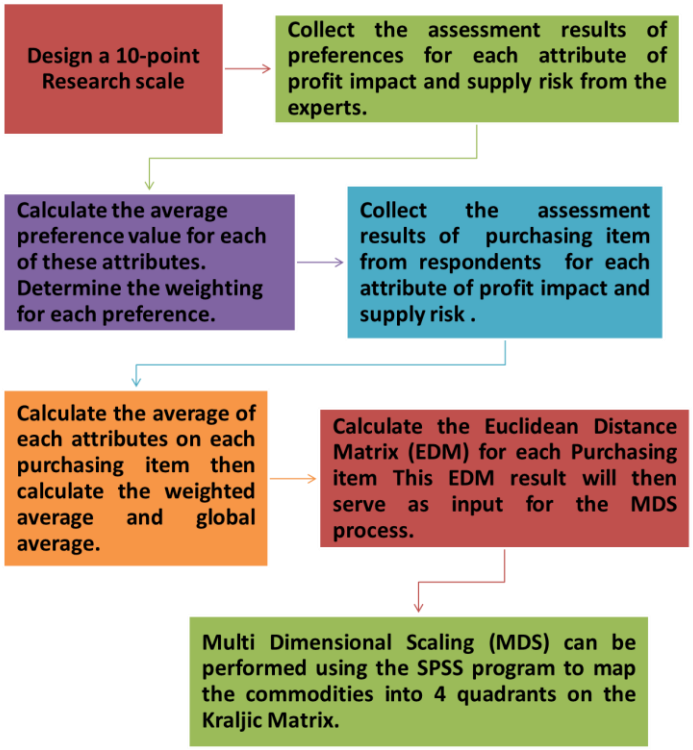

Figure 2: The steps of Mapping Purchasing Item on Kraljic Matrix

Before conducting the assessment questionnaire on the purchasing items, a preliminary questionnaire was first carried out to determine the preference ratings of procurement experts regarding the importance of each factor to be evaluated at PT X, as previously explained. The score for each studied factor was obtained by calculating the average preference score from the three experts. The average scores of all factors were then summed. To calculate the percentage of the preference score for each factor, the average score of each factor was divided by the total sum of all average scores and then multiplied by 100%. The results of the preference score assessment questionnaire are shown in the following table:

Table 4 Result of Preferences Score by the Experts

On a scale of 1-10 (1: very low, 10: very high), how would you rate the supply risk and profit impact for each purchasing item?					
Supply Risk			Profit Impact		
Market Risk	Performance Risk	Complexity Risk	Impact on Profitability	Critically of Purchase	Cost/value of Purchasing
39%	28%	33%	35%	28%	38%

Based on Table 4 above, it can be observed that, in general, procurement experts assessed the supply risk factors in the following order from highest to lowest: Market Risk (39%), Complexity Risk (33%), and Performance Risk (28%). Meanwhile, in terms of profit impact, the factors with the

greatest influence are Cost/Value of Purchasing (38%), Impact on Profitability (35%), and Criticality of Purchase (28%). These data will be used to derive the weighted scores for the evaluation of purchasing items in the subsequent questionnaire.

To assess each purchasing item in terms of supply risk and profit impact, the questionnaire previously was distributed to 30 respondents who met the specified criteria. Through this questionnaire, respondents' evaluations of each purchasing item could be obtained and used as a data source for mapping the items into the Kraljic Matrix. Meanwhile, Table 5 below presents the results of the questionnaire responses from the supply risk perspective.

The weighted average was calculated by multiplying the preference score by the evaluation scores of each purchasing item for the respective assessed factors. The global average was then obtained by multiplying the weighted average by the priority weight of the dimension, where the supply risk dimension carries a weight of 60% and the profit impact dimension carries a weight of 40% (Ulkhaq & Pratiwi, 2024; Muningrum & Kusumastuti, 2021; Padhi et al., 2012). The results of the purchasing item assessments are shown in Table 5 below:

Table 5 The Results of The Purchasing Item Assessments on Supply Risk Dimension

No	Item code	Purchasing Item	Supply Risk				
			Market Risk	Performance Risk	Complexity Risk	Weighted Average	Global Average
1	99	Equipment, Installation, etc	7,53	7,50	6,60	7,22	4,33
2	56	Construction and Building Materials	6,90	7,50	6,33	6,88	4,13
3	68	Chemicals, Gasses, and Chemical Products	7,27	7,10	6,43	6,95	4,17
4	47	Pipes, Tubes, Hoses, and Fittings	7,07	6,83	6,13	6,69	4,02
5	95	Metal Bars, Sheets, and Shapes	6,90	7,00	5,90	6,60	3,96
6	59	Capacitors	7,20	7,23	5,53	6,66	4,00
7	80	Brush, Paint, Sealer, and Adhesive	7,03	6,73	5,97	6,60	3,96
8	61	Electrical Cables, Power and Distribution Equipment	6,87	6,90	6,40	6,72	4,03
9	53	Abrasive Hardware and Materials	6,97	7,13	6,07	6,72	4,03
10	49	Maintenance and Repair Workshop Equipment	6,83	7,00	5,60	6,48	3,89
11	66	Laboratory Instruments and Equipment	6,77	7,40	6,23	6,77	4,06
12	48	Valves	6,83	7,23	5,87	6,63	3,98
13	39	Material Handling Equipment	6,70	7,17	6,10	6,64	3,98
14	29	Machine Accessories	7,07	7,47	5,83	6,78	4,07
15	31	Bearing	7,17	7,07	6,27	6,84	4,11
16	72	Mess Equipment and Supplies	6,80	7,50	5,70	6,64	3,98
17	45	Plumbing, Heating, and Sewage Equipment	7,10	7,00	6,10	6,74	4,05

No	Item code	Purchasing Item	Supply Risk				
			Market Risk	Performance Risk	Complexity Risk	Weighted Average	Global Average
18	91	Fuels, Lubricants, Oils and Candles	6,80	7,37	6,00	6,70	4,02
19	34	Metal Cutting Machine	7,03	7,13	6,20	6,79	4,07
20	84	Clothing, Individual Equipment, and Insignia	6,70	7,17	5,67	6,49	3,90

Meanwhile, the results of the questionnaire for the profit impact dimension are presented in Table 6 below

Table 6 The Results of The Purchasing Item Assessments on Profit Impact Dimension

No	Item code	Purchasing Item	Profit Impact				
			Impact on profitability	Critically of purchase	Cost/value of purchasing	Weighted Average	Global Average
1	99	Equipment, Installation, etc	7,87	7,70	7,73	7,77	4,66
2	56	Construction and Building Materials	7,83	7,77	7,93	7,85	4,71
3	68	Chemicals, Gasses, and Chemical Products	7,23	7,30	7,87	7,49	4,49
4	47	Pipes, Tubes, Hoses, and Fittings	7,53	7,27	7,73	7,53	4,52
5	95	Metal Bars, Sheets, and Shapes	7,13	7,50	7,80	7,49	4,49
6	59	Capacitors	7,40	7,40	8,07	7,65	4,59
7	80	Brush, Paint, Sealer, and Adhesive	7,30	7,00	7,23	7,19	4,31
8	61	Electrical Cables, Power and Distribution Equipment	7,40	7,50	8,17	7,72	4,63
9	53	Abrasive Hardware and Materials	7,03	7,60	8,20	7,63	4,58
10	49	Maintenance and Repair Workshop Equipment	7,57	7,43	7,50	7,50	4,50
11	66	Laboratory Instruments and Equipment	7,30	7,30	8,33	7,69	4,61
12	48	Valves	7,57	7,83	7,57	7,64	4,58
13	39	Material Handling Equipment	7,50	7,30	7,80	7,56	4,53
14	29	Machine Accessories	7,67	7,67	7,97	7,78	4,67
15	31	Bearing	7,43	7,27	7,27	7,32	4,39
16	72	Mess Equipment and Supplies	6,67	7,00	8,20	7,33	4,40
17	45	Plumbing, Heating, and Sewage Equipment	7,20	7,37	7,30	7,28	4,37
18	91	Fuels, Lubricants, Oils and Candles	7,00	7,53	7,97	7,51	4,51

No	Item code	Purchasing Item	Profit Impact				
			Impact on profitability	Criticality of purchase	Cost/value of purchasing	Weighted Average	Global Average
19	34	Metal Cutting Machine	7,27	6,73	7,80	7,32	4,39
20	84	Clothing, Individual Equipment, and Insignia	6,80	7,33	7,57	7,24	4,34

After obtaining the evaluation scores for each purchasing item, the analysis proceeds using the Euclidean Distance Matrix (EDM). The global average scores for each purchasing item serve as inputs for the EDM analysis. In this context, EDM is applied as a quantitative approach to measure the proximity or similarity between purchasing items based on the evaluation attributes—namely, supply risk and profit impact. By squaring the differences in attribute scores between items, Euclidean distance provides an objective basis for comparing items and performing clustering.

The application of Euclidean Distance is particularly useful for identifying groups of items with similar characteristics, which can later be mapped into the same quadrant within the Kraljic Matrix. For example, two items with a small Euclidean distance share similar levels of supply risk and financial impact, suggesting they may belong in the same quadrant. Research by Scardapane et al. (2016) explains that the Euclidean Distance Matrix can be used for distributed data reconstruction and clustering, making it highly suitable for companies with multiple procurement units. Furthermore, Mimmack et al. (2001) emphasize that Euclidean distance is appropriate when all variables are measured on the same scale, as is the case in this study using a 1–10 questionnaire scale for supply risk and profit impact.

In the context of classifying items within the Kraljic Matrix, the use of distance matrices has also been validated in a study by Handoko & Rinawati (2014), who combined Euclidean distance with Multi-Dimensional Scaling (MDS) to map commodities based on their risk weight and profit impact. This approach offers a highly intuitive spatial representation, which can be directly used to support strategic decisions such as long-term contracts, supplier diversification, or supplier alliances. The results of the EDM calculation are presented in Figure 2 below:

Item Code	29	31	34	39	45	47	48	49	53	56	59	61	66	68	72	80	84	91	95	99
29	0	0,28	0,28	0,16	0,30	0,15	0,12	0,24	0,10	0,08	0,10	0,05	0,06	0,20	0,28	0,37	0,37	0,17	0,21	0,27
31	0,28	0	0,03	0,19	0,06	0,15	0,23	0,25	0,20	0,32	0,22	0,25	0,22	0,12	0,12	0,17	0,22	0,14	0,17	0,35
34	0,28	0,03	0	0,17	0,03	0,14	0,22	0,22	0,19	0,33	0,21	0,24	0,22	0,14	0,09	0,14	0,18	0,13	0,15	0,37
39	0,16	0,19	0,17	0	0,18	0,04	0,05	0,10	0,07	0,23	0,06	0,11	0,11	0,19	0,13	0,22	0,21	0,05	0,05	0,37
45	0,30	0,06	0,03	0,18	0	0,15	0,22	0,21	0,21	0,35	0,23	0,26	0,24	0,17	0,07	0,10	0,15	0,14	0,15	0,41
47	0,15	0,15	0,14	0,04	0,15	0	0,07	0,13	0,06	0,22	0,07	0,11	0,1	0,15	0,12	0,21	0,22	0,01	0,06	0,34
48	0,12	0,23	0,22	0,05	0,22	0,07	0	0,12	0,05	0,20	0,02	0,07	0,09	0,21	0,18	0,27	0,26	0,09	0,09	0,36
49	0,24	0,25	0,22	0,10	0,21	0,13	0,12	0	0,16	0,32	0,14	0,19	0,21	0,28	0,14	0,20	0,16	0,13	0,08	0,47
53	0,10	0,20	0,19	0,07	0,21	0,06	0,05	0,16	0	0,17	0,04	0,05	0,05	0,16	0,18	0,27	0,27	0,07	0,11	0,31
56	0,08	0,32	0,33	0,23	0,35	0,22	0,20	0,32	0,17	0	0,18	0,13	0,12	0,22	0,34	0,43	0,44	0,23	0,28	0,21
59	0,10	0,22	0,21	0,06	0,23	0,07	0,02	0,14	0,04	0,18	0	0,05	0,07	0,20	0,19	0,28	0,27	0,09	0,11	0,34
61	0,05	0,25	0,24	0,11	0,26	0,11	0,07	0,19	0,05	0,13	0,05	0	0,03	0,19	0,23	0,32	0,32	0,12	0,16	0,30
66	0,06	0,22	0,22	0,11	0,24	0,10	0,09	0,21	0,05	0,12	0,07	0,03	0	0,16	0,23	0,32	0,32	0,11	0,16	0,27
68	0,20	0,12	0,14	0,19	0,17	0,15	0,21	0,28	0,16	0,22	0,20	0,19	0,16	0	0,21	0,27	0,31	0,15	0,21	0,23
72	0,28	0,12	0,09	0,13	0,07	0,12	0,18	0,14	0,18	0,34	0,19	0,23	0,23	0,21	0	0,09	0,10	0,11	0,09	0,44
80	0,37	0,17	0,14	0,22	0,10	0,21	0,27	0,20	0,27	0,43	0,28	0,32	0,32	0,27	0,09	0	0,07	0,20	0,18	0,51
84	0,37	0,22	0,18	0,21	0,15	0,22	0,26	0,16	0,27	0,44	0,27	0,32	0,32	0,31	0,10	0,07	0	0,21	0,16	0,54
91	0,17	0,14	0,13	0,05	0,14	0,01	0,09	0,13	0,07	0,23	0,09	0,12	0,11	0,15	0,11	0,20	0,21	0	0,06	0,35
95	0,21	0,17	0,15	0,05	0,15	0,06	0,09	0,08	0,11	0,28	0,11	0,16	0,16	0,21	0,09	0,18	0,16	0,06	0	0,41
99	0,27	0,35	0,37	0,37	0,41	0,34	0,36	0,47	0,31	0,21	0,34	0,30	0,27	0,23	0,44	0,51	0,54	0,35	0,41	0

Figure 2: The Results of The EDM Calculation

After the EDM calculations for each purchasing item are obtained, the results are then used as input for Multi-Dimensional Scaling (MDS). Multidimensional Scaling (MDS) is an exploratory statistical method used to visually represent the relationships among objects in a two-dimensional space (scatter plot), based on perceived or calculated distances between the objects.

This data processing is performed using SPSS software, where SPSS processes the distance data using an algorithm that seeks to minimize the "Stress" value, which measures the discrepancy between the input distances and their graphical representation. The MDS output is then used to display the position or location of each purchasing item for further analysis, consisting of two dimensions: Dimension 1: Supply Risk and Dimension 2: Profit Impact (Giguère, 2006). The results of the MDS analysis are presented in Table 7 below:

Table 7. The results of the MDS analysis

Item Code	Supply risk	Profit Impact	Item Code	Supply risk	Profit Impact
29	0,69	-0,29	59	0,20	-0,37
31	-0,22	0,56	61	0,45	-0,36
39	-0,15	-0,08	66	0,46	-0,18
34	-0,37	0,26	68	0,29	0,52
45	-0,52	0,42	72	-0,58	0,04
47	-0,04	-0,17	80	-0,93	0,31
48	0,10	-0,44	84	-1,04	0,07
49	-0,45	-0,55	91	-0,04	-0,04
53	0,23	-0,19	95	-0,32	-0,25
56	1,01	-0,17	99	1,22	0,91

Based on the coordinate positions of each purchasing item as previously presented in Table 7, the Kraljic Matrix mapping results for each purchasing item at PT X are shown in Figure 3 below:

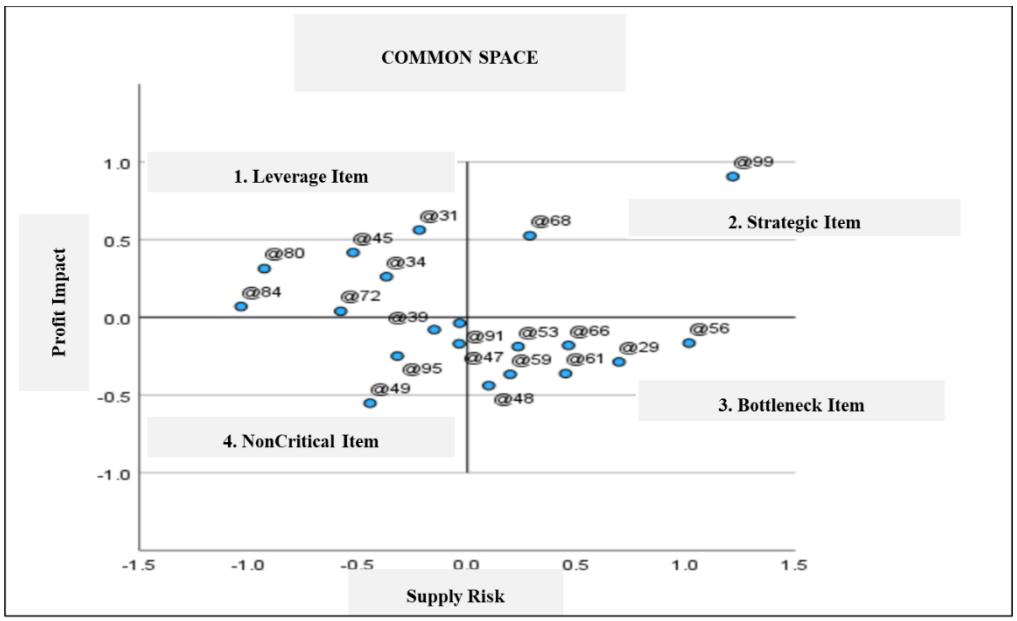

Figure 3: Mapping of Kraljic Matrix

The first quadrant is Leverage Items, which are items with low supply risk but high profit impact. Purchasing items classified in this quadrant include Brushes, Paint, Sealers, Adhesives, and Chemicals (item code 80), Bearings (item code 31), Mess Equipment and Supplies (item code 72), Plumbing, Heating, and Waste Disposal Equipment (item code 45), Metal Cutting Machines (item code 34), and Clothing, Individual Equipment, and Insignia (item code 84). These items are relatively easy to find in the market with many available suppliers, but they have high monetary value and significantly affect total procurement costs. Leverage items, while associated with lower supply risk, carry significant financial weight. Improper coordination in this category may lead to lost cost-saving opportunities through missed bulk discounting or inefficient supplier negotiations. Therefore, the recommended strategy is to leverage the company's bargaining power, consolidate purchases to obtain volume discounts, and apply competitive tendering. The primary focus is on cost efficiency

The second quadrant is Strategic Items, which are items with both high supply risk and high profit impact. Items in this quadrant include Main Equipment, Installation, and others (item code 99), as well as Chemicals and Chemical Gas Products (item code 68). These items are critical to the continuity of operations or projects and are difficult to replace or source from multiple suppliers. These items are characterized by supplier scarcity and critical operational importance, making them particularly vulnerable to delays and misaligned specifications—two of the primary causes of cost overruns identified at PT X. Without strategic supplier relationships and early engagement, disruptions in these categories can severely affect project timelines and cost performance. Therefore, the most appropriate procurement strategy is to establish long-term partnerships with suppliers, conduct regular performance monitoring, and involve suppliers early in the planning process. The goal is to ensure supply continuity, price stability, and consistent quality.

The third quadrant is Bottleneck Items, which are items with high supply risk but low profit impact. Purchasing items in this quadrant include Construction Materials and Building Supplies (item code 56), Electrical and Electronic Equipment Components (item code 59), Electrical Cables, Power Equipment, and Distribution Systems (item code 61), Laboratory Instruments and Equipment (item code 66), Valves (item code 48), and Machine Accessories (item code 48). Although these items may not represent the largest portion of total spending, their delay or absence can disrupt production processes. For this category, companies should develop risk mitigation strategies such as maintaining safety stock, sourcing alternative suppliers or technical substitutions, and strengthening supplier relationships to ensure prioritized supply. Despite their lower cost contribution, procurement issues in these categories—such as limited supplier availability or technical specificity—can cause procurement bottlenecks, leading to urgent purchasing or substitute materials that may not meet project standards. This misalignment often results in unforeseen expenditures and procedural inefficiencies.

Finally, the fourth quadrant is Non-Critical Items. This quadrant includes items with low supply risk and low profit impact. Purchasing items in this group include Pipes and Tubes (item code 47), Bars, Sheets, and Metal Shapes (item code 95), Workshop Maintenance and Repair Equipment (item code 49), Material Handling Equipment (item code 39), and Fuels, Lubricants, Oils, and Waxes (item code 91). Since their procurement is low-risk and they have minimal impact on business strategy, the appropriate approach is to simplify the purchasing process, automate procurement, and use electronic catalogues for efficiency and administrative ease. Non-Critical items, although representing lower risk and financial impact, still require process optimization to avoid administrative errors and minimize procedural delays. Table 8 below summarizes the purchasing items for each quadrant of the Kraljic Matrix.

Table 8 List of Classification of Purchasing Item Based on Kraljic Matrix

Leverage Item	Strategic Item
Brush, Paint, Sealer, and Adhesive	Equipment, Installation, etc
Bearing	Chemicals, Gasses, and Chemical Products
Mess Equipment and Supplies	
Plumbing, Heating, and Sewage Equipment	
Metal Cutting Machine	
Clothing, Individual Equipment, and Insignia	
Non critical Item	**Bottleneck Item**
Pipes, Tubes, Hoses, and Fittings	Construction and Building Materials
Metal Bars, Sheets, and Shapes	Capacitors
Maintenance and Repair Workshop Equipment	Electrical Cables, Power and Distribution Equipment
Material Handling Equipment	Hardware and Abrasives
Fuels, Lubricants, Oils and Candles	Laboratory Instruments and Equipment
	Valve
	Machine Accessories

5. CONCLUSION

This study aims to improve the procurement process in the Smelter Project at PT X, which faced a cost overrun of 71.08%. The main issues were poor planning, delivery delays, and mismatched item specifications. PT X did not use a material classification system, treating all items the same regardless of their importance. The researchers analysed 53 purchasing items based on procurement data from 2022 to 2024. Through spend analysis, 20 purchasing items—accounting for 97% of the total procurement value—were identified as the most critical for analysis. Based on the mapping results using the Kraljic Matrix, "Equipment, Installation, etc." and "Chemicals, Gasses, and Chemical Products" were categorized as strategic items with both high supply risk and high profit impact.

The findings offer practical implications for PT X and similar industrial project owners. Differentiated procurement strategies should be adopted based on item classification: strategic items require long-term partnerships and risk mitigation planning, leverage items demand volume-based negotiation, bottleneck items necessitate contingency sourcing strategies, and non-critical items can benefit from automation and e-procurement tools. Applying such tailored strategies can improve procurement efficiency and reduce the risk of cost overruns in future projects.

This research contributes to the growing body of knowledge on strategic procurement by integrating the Kraljic Matrix with quantitative scoring, expert judgment, and multi-dimensional scaling. It provides empirical evidence for the applicability of portfolio-based procurement classification in large-scale infrastructure projects in developing countries, particularly Indonesia.

Future research may expand this approach by incorporating additional variables such as environmental risk, supplier financial health, or geopolitical uncertainty. Moreover, the application of fuzzy logic or Analytic Hierarchy Process (AHP) could further refine the weighting process. Comparative studies across industries or international settings would also enhance generalizability and offer broader policy insights.

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