



Integrating Importance Performance Analysis and House of Risk for Service Improvement and Risk Mitigation in Procurement

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Abstract. This study aims to evaluate the quality of procurement services and identify supply chain risks in the procurement process at PT XYZ through the integration of the Importance Performance Analysis (IPA) and House of Risk (HOR) methods. The IPA method is used to assess the gap between user expectations and perceptions of service quality, while the HOR method identifies and prioritizes risk agents based on the Aggregate Risk Potential (ARP) for proactive risk mitigation. Data were collected from 100 respondents within the Directorate of Operations and Production at PT XYZ. The results of the IPA show that the attributes with the largest gaps are RE1 (timeliness of delivery) and RES1 (administrative service time), both requiring urgent improvement. Sixteen risk events and risk agents were identified, with the highest ARP value attributed to A02 (human resource inadequacy in contract award processes). The proposed improvement strategies were evaluated for effectiveness and implementation difficulty to determine priority actions. The findings demonstrate that the integration of IPA and HOR effectively identifies performance issues and risk factors, and supports strategic decision-making in supply chain risk mitigation and service quality improvement for procurement processes.

Keywords: Aggregate Risk Potential , House of Risk, Importance Performance Analysis, Risk.

1 Introduction

Globalization signifies an unprecedented increase in micro and macro-level competition, leading to trade transactions involving goods, services, production factors, and institutions that transcend national borders [1]. This condition has intensified business competition and introduced numerous factors determining an entity's competitive advantage. The role of the supply chain has become increasingly critical, with various disruptions in operational processes and financial losses resulting from uncontrollable events that destabilize the supply chain, thus heightening concerns over risks in inventory and production materials [2].

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Supply chain management is not limited to regulating and organizing material and product supply across stages. Still, it encompasses planning and coordinating all procurement, conversion, and logistics activities, including coordination with stakeholders such as raw material suppliers, third-party service providers, and customers [3]. A well-integrated supply chain system can significantly enhance a company's ability to respond quickly and effectively to market changes [4]. Specifically, procurement is one of the most crucial activities in supply chain management. Effective inventory management offers strategic advantages in the competitive manufacturing industry, such as enhancing supply chain resilience, mitigating disruptions, improving resource efficiency and cost savings, fostering strong supplier relationships, and reducing total value chain costs [5]–[7].

PT XYZ is a manufacturing company that produces urea fertilizer to meet the demand in western Indonesia, a predominantly agricultural region. The market scope it controls makes its procurement process particularly sensitive. Several issues persist in the procurement process, such as delayed deliveries, late issuance of purchase orders (POs), and discontinued requested specifications. Interventions are needed to improve the current supply chain system to face challenges, competition, and uncertainty and mitigate inevitable unforeseen events [8]–[10].

Popular supply chain analysis methods include Importance Performance Analysis (IPA) and the House of Risk (HOR) method. IPA analyzes gaps between customer perceptions and expectations regarding service/product quality, aiming to assess customer satisfaction based on various attributes and identify managerial actions for service improvement. IPA provides and visualizes information about which attributes should be prioritized for improvement based on consumer perspectives and their significant impact on satisfaction. It enables analysts to identify essential factors requiring swift and effective enhancements [11]–[14].

Meanwhile, the HOR method analyzes risk using principles from Failure Mode and Effect Analysis (FMEA) and House of Quality (HOQ). HOR identifies supply chain risks based on risk agents that should be prioritized for preventive actions, determined by each agent's Aggregate Risk Potential (ARP) [15], [16]. Integrating these two methods is expected to generate effective improvement strategies and risk mitigation in the supply chain to enhance service quality.

IPA and HOR methods have been applied across sectors for supply chain and service analysis. Aghajanzadeh [14] applied the IPA method to assess public transport user satisfaction with Tehran Metro during the COVID-19 pandemic. The results showed that the most critical service attributes were congestion, peak-hour performance, cleanliness, and temperature/ventilation. Meanwhile, Rochmoeljati [17] implemented supply chain risk analysis in the sugar industry in Sidoarjo, Indonesia. The study applied the SCOR and HOR models to identify processes and potential risks, revealing 13 risk agents originating from planning, procurement, production, and delivery stages—with the most dominant risks stemming from production and procurement processes.

The implementation of IPA and HOR in this study aims to assess service quality, recommend improvements based on the most influential satisfaction attributes, and analyze and mitigate risks in PT XYZ's procurement supply chain process. The novelty of this study lies in integrating both methods, aiming to enhance service quality while

simultaneously identifying and mitigating risks that impact overall supply chain performance within a production system.

2 Methodology

This study was conducted at PT XYZ, which is located in North Aceh, Indonesia. The research was carried out within the procurement process, which is integrated with equipment maintenance planning, material planning, procurement, warehousing, sales, and reporting processes. The study employed the Importance Performance Analysis (IPA) method to analyze the gap between user perceptions and expectations regarding procurement services. It then assessed the risks that may arise within the supply chain of goods and services procurement. It provided improvement recommendations and risk mitigation strategies using the House of Risk (HOR) method. The population of this study consisted of 386 employees from the Directorate of Operations and Production. The sample size was determined using Slovin's formula, as the population size was known. The sampling process was conducted using Equation 1 [18].

$$n = \frac{N}{1 + N(e)^2}$$

$$n = \frac{386}{1 + 386(0.10)^2}$$

$$n = 79,423' \approx 80 \text{ respondent}$$

The respondents in this study were determined using the entire population of the working units, with a margin of error set at 10%, resulting in a minimum required sample size of 80 respondents. To minimize sampling errors caused by respondents who may not meet the criteria, the study employed 100 respondents. These respondents were then given a questionnaire containing assessment items based on the Importance Performance Analysis (IPA) method. The indicators used in the questionnaire statements are presented in Table 1.

Table 1. Indicator IPA

Code	Dimensions	Indicators
TA1	Tangibility	The service provider prepares orders in accordance with user requests.
TA2		The service provider provides accurate status information in the portal system.

Code	Dimensions	Indicators
TA3		The service provider supplies all necessary information such as job status, PO number, delivery details, etc.
TA4		The display of information on the portal regarding the status of procurement requests is attractive.
TA5		The information services on the portal regarding procurement request status meet user needs.
RE1		Timeliness in the delivery of goods or execution of services.
RE2		The requested goods delivered or services provided are in good quality condition.
RE3	Reliability	The service provider is responsive in handling repeated order requests.
RE4		The service provider delivers consistent service quality for every procurement request submission.
RES1	Responsive-ness	The administrative service time by the provider is not time-consuming.
RES2		Business processes/procedures for the service are simple and efficient.
AS1	Assurance	Service provider staff possess knowledge, skills, and behavior that meet expectations in delivering services.
AS2		Service provider staff are trustworthy.
EM1	Empathy	Service provider staff understand your specific needs.
EM2		The service provider addresses and resolves problems.

3 Result and Discussion

3.1 IPA Analysis

The analysis of procurement service quality was conducted by comparing users' expectations of the service with their perceptions of the quality of service received. Table 2 presents the assessment of the gap between user perceptions and expectations regarding the expected service quality in this study.

Table 2. GAP Value

Code	Customer		Gap
	Perception	Expectation	
Tangibility			
TA1	4,16	4,16	0,00
TA2	3,94	4,17	-0,23
TA3	3,95	4,18	-0,23
TA4	3,86	4,14	-0,28
TA5	3,84	4,15	-0,31
Average	3,95	4,16	-0,21
Reliability			
RE1	3,02	4,34	-1,32
RE2	4,01	4,21	-0,20
RE3	4,11	4,16	-0,05
RE4	4,12	4,19	-0,07
Average	3,82	4,23	-0,41
Responsiveness			
RES1	3,39	4,31	-0,92
RES2	3,94	4,19	-0,25
Average	3,67	4,25	-0,59
Assurance			
AS1	4,12	4,21	-0,09
AS2	4,15	4,20	-0,05
Average	4,14	4,21	-0,07

Code	Customer		Gap
	Perception	Expectation	
Empathy			
EM1	4,08	4,20	-0,12
EM2	4,05	4,20	-0,15
Average	4,07	4,20	-0,14

The gap between users' expectations and perceptions of service quality is presented in **Table 2**. It was found that the dimension with the **smallest gap** is the **assurance** dimension, with an average gap value of -0.07, while the largest gap occurs in the responsiveness dimension, with a value of -0.59. This indicates that the assurance dimension most closely meets customer expectations in the service provided, whereas the responsiveness dimension still requires significant improvement to meet customer expectations. The gap analysis is then visualized using the IPA Cartesian diagram to classify indicators based on the level of improvement needed according to performance (perception) and importance (expectation). The IPA Cartesian diagram visualization is shown in Fig. 1.

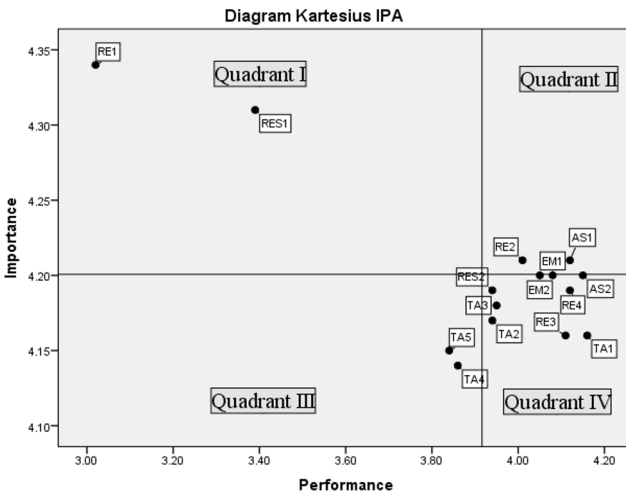


Fig. 1. IPA Cartesian diagram

Fig. 1 illustrates the performance and importance assessment of procurement services at PT XYZ. It shows that the main priorities for improvement are indicators RE1 and RES1, which are located in Quadrant I of the IPA diagram.

3.2 HOR Analysis

House of Risk (HOR) method combines fundamental concepts from the House of Quality and Failure Mode and Effect Analysis (FMEA) and is used for proactive risk management [19]. The severity level (S_i) is measured on a scale of 1 to 10, where a score of 10 indicates a highly severe impact of the risk event. Meanwhile, the occurrence likelihood (O_j) is also assessed on a 1 to 10 scale, where a score of 1 indicates that the risk agent rarely occurs, while a score of 10 suggests that the risk agent occurs in most cases [20]. The risk events and risk agents in the procurement process at PT XYZ were then assessed based on the scale criteria presented. Table 3 presents the results of the risk event and risk agent assessments in the supply chain of the goods and services procurement process at PT XYZ.

Table 3. Risk Event and Risk Agent Assessment

Code	Risk Event/ Risk Agent	Severity	Occurrence
A01	Excessive unloading time during delivery	8	1
A02	Delay in issuing appointment and award letters	9	7
A03	Delivery distance from source to PT XYZ location is difficult to access	9	4
A04	Supplier performance does not meet user requirements	9	4
A05	Insufficient quorum for procurement execution	9	3
A06	Incomplete administrative requirements and documentation	9	5
A07	Natural disasters	9	1
A08	Sudden changes in the Master Schedule	9	2
A09	Unfit transport vehicle conditions, causing replacement delays	9	1

Code	Risk Event/ Risk Agent	Severity	Occurrence
A10	Inadequate employee human resources in terms of quality and quantity	9	6
A11	Suppliers' unfamiliarity with E-Procurement system	4	4
B01	Delays in confirming technical specifications	8	6
B02	Misunderstanding of requested specifications	8	6
B03	Delays in responding to OE/HPS confirmation	8	3
B04	Errors in determining OE/HPS	8	3
B05	Delay in issuance of job completion minutes	8	3

There are 16 risk events and risk agents identified in the supply chain procurement process at PT XYZ. It was found that 15 risk events have the potential to cause severe impacts, with severity (Si) values ranging from 8 to 9, while 4 risk agents exhibit moderate occurrence potential, with occurrence (Oj) values ranging from 6 to 7. The identified risk events and risk agents were then analyzed to determine the correlation between each risk event and its corresponding agent(s), followed by ranking based on Aggregate Risk Potential (ARP) values to establish improvement priorities [21].

Table 4. ARP Value Calculation

Code	Oj	Sj	Rij	ARP	Rank	%ARP	%Cumulative
			RES 1	RE 2			
A01	1	8	9	9	144	15	1,68%
A02	7	9	9	9	1134	1	13,22%
A03	4	9	9	9	648	6	7,56%
A04	4	9	9	9	648	6	7,56%

Code	Oj	Sj	Rij		ARP	Rank	%ARP	%Cumulative
			RES 1	RE 2				
A05	3	9	9	9	486	8	5,67%	35,68%
A06	5	9	9	9	810	5	9,44%	45,12%
A07	1	9	9	9	162	14	1,89%	47,01%
A08	2	9	9	9	324	11	3,78%	50,79%
A09	1	9	0	9	81	16	0,94%	51,73%
A10	6	9	9	9	972	2	11,33%	63,06%
A11	4	4	9	9	288	12	3,36%	66,42%
B01	6	8	9	9	864	3	10,07%	76,50%
B02	6	8	9	9	864	3	10,07%	86,57%
B03	3	8	9	9	432	9	5,04%	91,61%
B04	3	8	9	9	432	9	5,04%	96,64%
B05	3	8	9	3	288	12	3,36%	100,00%

Table 4. The results of the ARP calculation and the cumulative percentage weight of each risk event and agent are presented. Risk agent A02 had the highest ARP value, 13.22%, making it the top priority for improvement. Conversely, risk agent A09 recorded the lowest ARP value, 0.94%. The cumulative ARP weight distribution is then visualized using a Pareto diagram.

Fig. 2. ARP Pareto Diagram

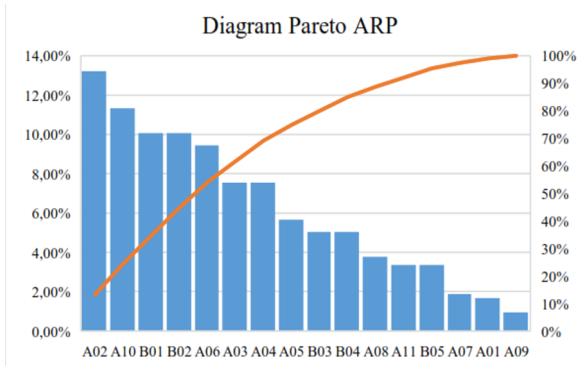


Fig. 2 presents the results of the ARP calculation in the form of a Pareto diagram. The risk agent with the highest ARP value is A02, while A09 holds the lowest ARP value. Proactive improvement strategies are then proposed to mitigate these risks. The proposed improvement strategies are presented in Table 5.

Table 5. Proactive Improvement Strategies

Rank	Risk Agent	Code	ARP	Improvement Strategy
1	A02	PA1	1134	Conduct regular training sessions for all employees
2	A10	PA2	972	Provide an integrated information system facility
3	B01	PA3	864	Ensure a clean and comfortable working environment for employees
4	B02	PA4	864	Implement reward and punishment systems, and provide motivational support to all staff
5	A06	PA5	810	Develop forecasting methods tailored to organizational needs
6	A03	PA6	648	Establish work commitment agreements with all registered partners
7	A04	PA7	648	Consider alternative suppliers
8	A05	PA8	486	Develop standard operating procedures (SOPs) for supplier performance evaluation
9	B03	PA9	432	Strengthen collaboration with other departments in OE determination
10	B04	PA10	432	Define clear criteria for supplier assessment
11	A08	PA11	324	Create standardized checklists for procurement

processes				
12	B05	PA12	288	Review past maintenance reports to improve future planning
13	A11	PA13	288	Conduct benchmarking with similar companies
14	A07	PA14	162	Provide new facilities to enhance service delivery in working units
15	A01	PA15	144	Recalculate minimum and maximum inventory levels
16	A09	PA16	81	Maintain active communication regarding any changes or additions to required documents

Table 5. The proposed 16 risk mitigation strategies represent improvement actions for addressing identified risk agents. These improvement strategies were selected to determine the primary priorities for action. The correlation values between each improvement action and the associated risk agents were evaluated to assess the effectiveness of the proposed mitigation strategies.

Table 6. Risk Mitigation Strategies

Risk Agent	ARPj	TEK	Degree of Difficulty (DK)	ETDk	Rank
A10	972	47844	3	15948	1
A02	1134	55404	4	13851	2
B01	864	36126	3	12042	3
B02	864	33228	3	11076	4
B03	432	25110	3	8370	5
A05	486	25029	3	8343	6
B05	288	24138	3	8046	7
B04	432	22032	3	7344	8
A08	324	21816	3	7272	9
A04	648	25461	4	6365,25	10

A09	81	17010	3	5670	11
A03	648	14499	3	4833	12
A11	288	14202	3	4734	13
A01	144	12258	3	4086	14
A06	810	10530	3	3510	15
A07	162	8478	3	2826	16

Table 6. The results present the calculation of the total effectiveness ratio of proposed improvement actions for each risk agent, based on the Effectiveness Score (TEK) and the difficulty of implementation. The risk agent with the highest improvement priority is A02, related to the lack of adequate human resources for the efficient preparation of appointment and award letters, with a ratio value of 15,948. Meanwhile, the risk agent with the lowest priority is A09, concerning transportation tools (i.e., cargo vehicles), which are considered to require no urgent intervention.

The findings of this study indicate that the integration of IPA and HOR methods can be effectively applied to improve performance and service quality and mitigate supply chain risks in the procurement process at PT XYZ. The IPA method identified that the least satisfactory service attributes were RE1 in the Reliability dimension and RES1 in the Responsiveness dimension. This is consistent with the findings of Keikavoosi-Arani [22], who concluded that the dimensions most unable to meet user expectations are Reliability and Responsiveness. Meanwhile, applying the HOR method was found to be aligned with improvement priorities and serves as an effective strategy for supply chain risk mitigation. Fitra [23] similarly concluded that implementing the HOR and IPA methods effectively addresses and mitigates supply chain risks.

4 Conclusion

This study indicates that supply chain risk and service quality analysis using the IPA and HOR methods has provided a comprehensive overview of the procurement business process and the factors that pose threats to its smooth operation. The study identified 16 risk events and 16 risk agents in the procurement process at PT XYZ, with the main improvement priority concerning human resource factors related to contract award decisions. The implication of this research is a set of recommendations for mitigating risk sources within the procurement process. Further studies are

required to analyze supply chain risks across the entire business process of urea fertilizer manufacturing companies.

References

1. Slastanova, N., Palus, H., Sulek, R., Parobek, J., Slastanova, K.: The Benefits of Applying the Green Purchasing. *SHS Web of Conferences* 92, 06037 (2021).
2. Mrykhin, A. L., Antoshchuk, S. G.: Information Model for Assessing the Impact of Tactical Material Procurement Risk on Order Fulfillment in Make-to-Order Manufacturing. *Heriot Advances in Information Technology* 7(3), 243–252 (2024).
3. Francis, J. R., Mairose, B. M., Tichy, E. M.: 2020 — The Year the World Was Awakened to the Importance of Supply Chain Management. *Mayo Clinic Proceedings: Innovations, Quality & Outcomes* 5(1), 187–192 (2021).
4. Jiang, F., Isa, F. M., Ng, S. P., Bhatti, M.: The Impact of Supply Chain Integration to Supply Chain Responsiveness in Chinese Electronics Manufacturing Companies. *SAGE Open* 13, 1–19 (2023).
5. Tanveer, U., Hoang, T. G., Truong, H. Q., Ishaq, S., Gong, Y.: The critical role of procurement in the emergence of circular business models: Insights from multiple cases of Vietnamese manufacturers. *Business Strategy and the Environment* ?, 7689–7707 (2024).
6. Bag, S., Dhamija, P., Gupta, S., Sivarajah, U.: Examining the role of Procurement 4.0 towards remanufacturing operations and circular economy. *Production Planning and Control* 32, 1368–1383 (2021).
7. Nsabisigaba, F., Madichie, N.: The Role of Procurement Practice in Shaping Competitive Advantage. *Journal of Procurement and Supply Chain* 8, 67–77 (2024).
8. Abdullah, S.: Lean Manufacturing and Supply Chain Performance. *South Asian Management Review* 1, 67–74 (2022).
9. Nasser, M. A., Singh, R.: Supply Chain Challenges in Competitive World: A Systematic Review and Meta-Analysis of Manufacturing and Service Sectors. *American Journal of Industrial and Business Management* 14, 1563–1586 (2024).
10. Nel, J. D.: The role of supply chain risk mitigation strategies to manage supply chain disruptions. *Journal of Transport and Supply Chain Management* 18, 1–12 (2024).
11. Rizo, S., Sfakianaki, E., Kakouris, A.: Quality of Administrative Services in Higher Education. *European Journal of Education Management* 5, 115–118 (2023).
12. Zhou, X., Wang, Y., Ma, P.: Survey on the tourist satisfaction of rural homestay based on the theory of importance–performance analysis. *Frontiers in Psychology* 13, 1–11 (2022).
13. Wijaya, I. G. N. S., Triandini, E., Kabnani, E. T. G., Arifin, S.: E-commerce website service quality and customer loyalty using WebQual 4.0 with importance performances analysis and structural equation model: An empirical study in shopee. *Register: Jurnal Ilmiah Teknologi Sistem Informasi* 7, 107–124 (2021).
14. Aghajanzadeh, M., Aghabayk, K., Esmailpour, J., De Gruyter, C.: Importance–Performance Analysis (IPA) of metro service attributes during the COVID-19 pandemic. *Case Studies on Transport Policy* 10, 1661–1672 (2022).
15. Nugraha, I., Dewi, S., Winursito, Y. C., Sari, R. N., Cattleya, M.: Risk Analysis and Mitigation in Supply Chain with House of Risk (HOR) Approach in Bag Manufacturing Industry at XYZ Ltd. In: *Proceedings of the 3rd Asia Pacific International Conference on Industrial Engineering and Operations*, pp. 2621–2632. (2022).

16. Oktavera, R., Kurniawan, M. R., Saraswati, R., Sutejo, B.: Risk Management Analysis in Tobacco Supply Chain Using the House of Risk Method. *Journal of Applied Science, Engineering, Technology, and Education* **4**, 167–175 (2022).
17. Rochmoeljati, R., Dewi, S., Azizah, C. D.: Risk Analysis in the Supply Chain of Cane Sugar Industry in Sidoarjo. In: *MATEC Web of Conferences* **372**, 08001 (2022).
18. Nurkholis, N., Wilarso, Sukamto, P., Sobarnas, M. A., Jamaludin, S., Tsani, U. A.: Digital Survey for Customer Satisfaction of Regional Drinking Water Companies (PDAM) using the m Water Application and the Slovin Formula Method. In: *BIO Web of Conferences* **144**, 03006 (2024).
19. Purwaningsih, R., Hermawan, F. A.: Risk analysis of milkfish supply chains in Semarang using House of Risk approach to increase the supply chain resilience. In: *IOP Conference Series: Earth and Environmental Science* **649**, 012018 (2021).
20. Wahyuni, N., Trenggonowati, D. L., Ibrahim, M. M., Anggraeni, S. K., Ekawati, R., Febianti, E.: Application of House of Risk to analyze supply chain risks in MSMEs (food processing industry). *Journal of Industrial Services* **9**, 155 (2023).
21. Nafi'ah, A., Mahbubah, N. A.: Managing Risk on a Pharmacy Enterprise Supply Chain Using House of Risk Approach. *Journal of Knowledge Industrial Engineering* **8**, 167–182 (2021).
22. Keikavoosi-Arani, L., Moghadasi, J.: Evaluation of the quality of safe dental services based on the perception of patients with the IPA approach: a powerful diagnostic tool for managers. *BMC Health Services Research* **24**, (2024).
23. Lestari, F., Mas'ari, A., Meilani, S., Riandika, I. N., Hamid, A. B. A.: Risk Mitigation via Integrating House of Risk and Probability Impact Matrix in Halal Food Supply Chain. *Jurnal Teknik Industri* **22**, 138–154 (2021).

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