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Identifying Critical Delay Risks in Internal Corporate Procurement Through Business Process Mapping: A Case Study of Air Compressor System Projects

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Abstract

Internal corporate procurement plays an essential role in supporting project delivery performance, particularly in complex industrial systems involving multiple functional units, technical requirements, and global supply chain coordination. However, the procurement of air compressor systems remains vulnerable to delivery delays arising from uncertainties related to technical specifications, approval procedures, production capacity, component availability, and international logistics. This study aimed to analyze the existing business process structure for the internal procurement of air compressor systems at PT X and to identify potential risks at each stage of the procurement process that could contribute to delivery delays and contractual penalties. The study employed a qualitative case study design. Data were collected through document analysis, procurement project records from 2021–2024, direct observations, and in-depth interviews with personnel involved in project management, engineering, procurement, factory coordination, and logistics. The data were analyzed using business process mapping and qualitative risk identification based on the principles of ISO 31000 and the Project Management Body of Knowledge (PMBOK). The findings revealed that the procurement process comprised five major stages: technical planning and specification, internal approval, factory order placement, production and subvendor management, and logistics and delivery. Five major delay risks were identified: specification changes, approval delays, delayed factory order placement, subvendor component delays, and customs clearance and shipping disruptions. These risks increased procurement lead times and adversely affected project delivery performance. The study concluded that greater process standardization, stronger cross-functional coordination, and structured risk control mechanisms were necessary to minimize procurement delays and improve project delivery reliability.

INTRODUCTION

Internal corporate procurement refers to the fulfillment of a company's requirements for goods through orders placed with production units or factories within the same corporate group (Chopra et al., 2022; Hauke-Lopes et al., 2023; Voronova, 2022). At PT X, this mechanism is used to procure air compressor systems for delivery to customers across various industrial sectors, including power generation, oil and gas, manufacturing, and infrastructure. Internal corporate procurement differs from conventional external procurement because it requires extensive cross-functional and cross-border coordination, even though the

parties involved operate within the same corporate group. This complexity exposes the procurement process to various risks that can affect procurement lead times and overall project performance. In practice, the internal procurement of air compressor systems at PT X faces challenges related to factory production capacity, changes in technical specifications, export documentation readiness, component availability, and coordination among engineering, procurement, manufacturing, logistics, and project management functions. These risks may result in delivery delays that directly affect project milestones and compliance with contractual delivery obligations.

The complexity of internal corporate procurement for air compressor systems arises not only from the number of parties involved in the business process but also from the technical complexity of the systems being manufactured. An air compressor system is an integrated industrial system comprising mechanical, electrical, instrumentation and control, and air treatment subsystems that must function in a coordinated manner. Individual components may have different technical specifications, manufacturing requirements, and sourcing arrangements, requiring intensive coordination among manufacturing facilities and engineering, procurement, logistics, and project management functions across different countries. Consequently, changes to one component or subsystem may affect interconnected components, manufacturing activities, and the overall production and delivery schedule.

In addition to product complexity, procurement complexity is reflected in the extended business process from customer order receipt to final delivery. Each stage involves different organizational functions and substantial interdependencies. In general, the internal corporate procurement process for air compressor systems at PT X comprises several interconnected stages, beginning with customer order receipt and ending with delivery to the end customer. The process extends beyond procurement administration to include technical planning, internal approvals, coordination with global manufacturing facilities, production monitoring and control, export documentation, and international logistics. Because these activities are highly interdependent, delays at one stage may create cascading effects on subsequent activities and ultimately extend the overall procurement lead time.

Figure 1. Existing Internal Corporate Procurement Process of Air Compressor System at PT

Figure 1 illustrates the internal corporate procurement process for air compressor systems at PT X, beginning with the receipt of a customer purchase order, followed by internal approval, initial planning and scheduling, order placement with the global manufacturing facility, manufacturing and inspection, preparation of export and shipping documentation, and final delivery of the unit to the customer. The process flow demonstrates that procurement performance depends not only on purchasing activities but also on the coordination of multiple organizational functions across different geographical locations. The involvement of multiple stakeholders and the extended process chain increase the complexity of internal corporate procurement and its vulnerability to potential delays. Therefore, business process mapping is essential for understanding interdependencies among activities, identifying critical process points, and tracing potential risk sources that may lead to delivery delays and contractual penalties.

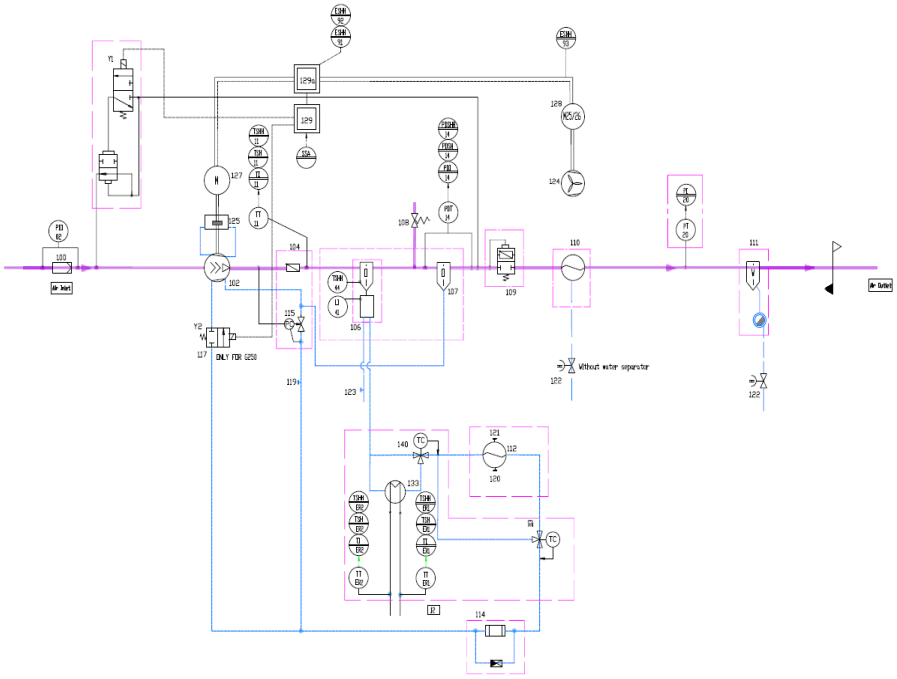

Figure 2. Process and Instrumentation Diagram (P&ID) Air Compressor System Include Component List

Table 1. Component List

NO	COMPONENT NUMBER	PART NAME
1	100	Air filter
2	101	Unloader
3	102	Oil injected screw compressor
4	104	Check Valve
5	106	Air - oil receiver
6	107	Oil separator element
7	108	Safety valve
8	109	Minimum pressure valve
9	110	Aftercooler
10	112	Oil cooler
11	113 & 136	Thermostatic valve
12	114	Oil filter with by-pass valve
13	115	Oil Stop Valve
14	117	Extra oil injection valve
15	119	Drain plug(s)
16	120	Drain oil cooler
17	121	Vent plugs
18	122	Cock
19	123	Drain plug
20	124	Fan blades air cooled
21	125	Coupling
22	127	Drive motor
23	128	Fan motor(s)
24	-	Fan assembly (Water cooler)
25	129	Control cubicle

26	-	Converter
27	Y1	Solenoid load/unload valve
28	Y11	Solenoid load/unload valve
29	Y4	Extra oil injection solenoid valve
30	acc. Note	temperature sensor
31	acc. Note	temperature switch
32	acc. Note	pressure transducer
33	acc. Note	Dp indicator
34	acc. Note	Dp transducer
35	-	Vibration dampers
36	111	Water Separator

Figure 2 illustrates the technical configuration of the air compressor system examined in this study. The diagram shows the interconnections among key components, including the compressor element, aftercooler, separator, filter, valves, pressure and temperature sensors, drive motor, control system, and compressed-air and condensate flow paths. The number and interdependence of these components demonstrate the technical complexity of the air compressor system. Each component is subject to specific design, manufacturing, inspection, and testing requirements; therefore, the procurement process requires extensive cross-functional and cross-border coordination among engineering, manufacturing, procurement, and logistics functions. This technical complexity increases the risk of procurement and delivery delays arising from specification changes, component availability constraints, or coordination issues throughout the procurement process.

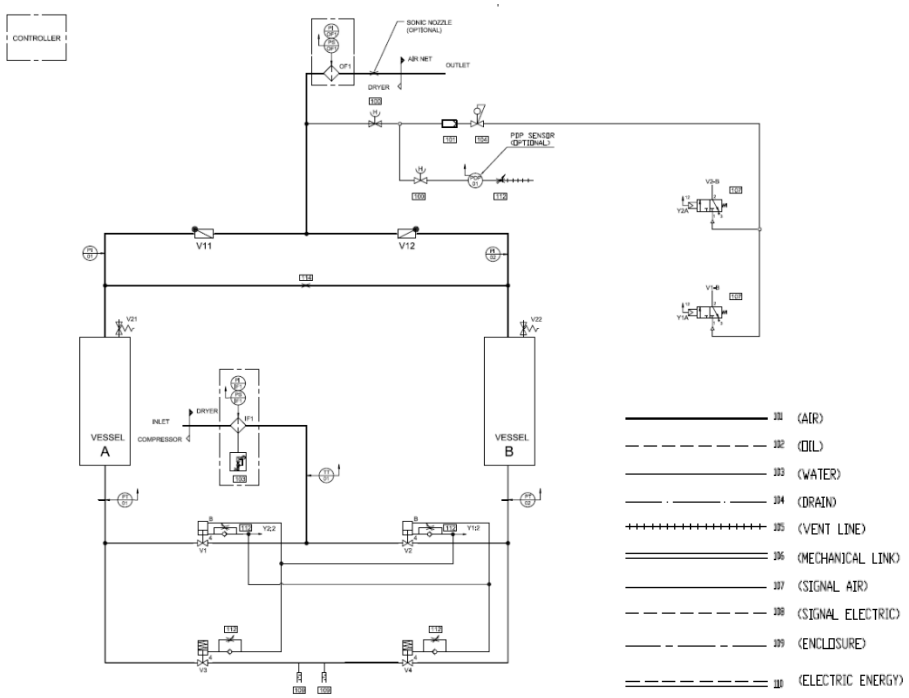

Figure 3. Operation Diagram and Control System of Dual Vessel Air Dryer in Air Compressor System Include Component List

Figure 3 illustrates one of the key subsystems of the air compressor system, namely the twin-tower desiccant air dryer, which reduces the water vapor content of compressed air

before it is distributed to the end user. The diagram shows the interaction between Vessel A and Vessel B, the regeneration system, control valves, pressure sensors, filters, and airflow paths, all of which must operate in an integrated manner. The complexity of this configuration demonstrates that an air compressor system comprises not only the main compressor unit but also various supporting subsystems with specific technical requirements. The procurement of these subsystems requires coordination among multiple entities within the corporate group, which may be located in different regions or countries. Therefore, systematic risk identification is necessary to anticipate potential delays arising from design changes, component production delays, documentation issues, or coordination barriers among the parties involved.

The combination of complex procurement business processes and the technical complexity of air compressor systems makes internal corporate procurement highly vulnerable to various sources of uncertainty. Delays in individual activities, whether caused by changes in technical specifications, internal approval processes, constraints on manufacturing capacity, or international logistics disruptions, may create cascading effects on subsequent process stages and jeopardize the overall project schedule. This condition indicates that each stage of the procurement process may contribute to the risk of delay. Therefore, understanding the business process structure and identifying risks at each procurement stage are essential for improving procurement performance, strengthening process controls, and reducing the likelihood of delays in customer delivery (PMI, 2021; ISO, 2018).

Based on initial observations and an evaluation of procurement project data for the 2021–2024 period, 24 of 86 projects, or approximately 27.9%, experienced delays in unit delivery. These delays increased exposure to contractual penalties, reduced supply chain efficiency, and potentially affected the company's reputation among customers. This situation indicates that procurement process controls have not yet been fully standardized and that several critical points remain susceptible to delays. According to Monczka et al. (2020), procurement plays a strategic role in organizations because it directly affects project performance, operational costs, and customer satisfaction. From a project management perspective, procurement extends beyond purchasing activities to include the management of risks that may affect the achievement of project objectives. PMI (2021) emphasizes that procurement management should be aligned with risk management because risks arising at each procurement stage may affect the project schedule and contractual obligations. Similarly, Kerzner (2022) explains that procurement management in project-based organizations should encompass administrative, technical, commercial, and contractual risk considerations to ensure alignment between procurement activities and project requirements.

From a managerial perspective, procurement activities should be aligned with established procurement-cycle and risk-management principles, including relevant guidance provided by the Project Management Body of Knowledge (PMBOK). Furthermore, Handfield and Nichols (2019) stated that effective procurement requires cross-functional integration to minimize risk, improve efficiency, and maintain a controlled workflow. Mushi et al. (2024) showed that effective cross-functional coordination significantly affects procurement performance because it facilitates information flow, accelerates decision-making, and supports the timely completion of interdepartmental activities. However, PT X

currently lacks an explicitly standardized standard operating procedure (SOP) for internal corporate procurement that specifically addresses the mitigation of delay risks and contractual penalties. The absence of such standardized procedures may contribute to inconsistent process execution, inadequate risk controls, and difficulties in monitoring critical points throughout the procurement process.

According to ISO 31000:2018, risk is the effect of uncertainty on objectives. In the procurement context, such uncertainty may result in delivery delays, cost increases, or disruptions to procurement outcomes. PMI (2017), in the sixth edition of the PMBOK Guide, similarly defines an individual project risk as an uncertain event or condition that, if it occurs, may have a positive or negative effect on one or more project objectives. In internal procurement processes, relevant risks are commonly associated with schedule performance, costs, quality requirements, and the fulfillment of contractual obligations.

Risks associated with procurement activities may be particularly complex because of interdependencies among multiple parties, multilayered approval processes, technical documentation requirements, and extended logistics activities. Berger et al. (2023) explain that supply chain disruptions can propagate across interconnected supply chain actors, meaning that a delay involving one supplier may generate ripple effects throughout the procurement network. Kerzner (2022) emphasizes that procurement risks may be substantial because of external-party involvement, cross-functional dependencies, and supply chain uncertainty. Therefore, comprehensive risk identification at each stage of the procurement process is essential for improving procurement performance and minimizing potential project delays. The importance of procurement risk identification has been highlighted in previous studies examining dominant risk sources and approaches to managing these risks.

Previous studies have shown that procurement risks commonly arise from document approval delays, specification changes, administrative discrepancies, inadequate cross-functional coordination, and supply chain disruptions. Andaru and Adi (2024) found that approval delays and document discrepancies were dominant risk factors in the e-procurement processes of engineering, procurement, and construction (EPC) projects. Meanwhile, Hanira and Djakman (2025) showed that specification changes and approval delays were major sources of procurement delay risk based on Failure Mode and Effects Analysis (FMEA). These findings are consistent with Li et al. (2023), who explained that design changes in complex products may trigger risk propagation across multiple project activities, including revisions to technical documentation, changes in production schedules, and increased project lead times.

Other studies have demonstrated the applicability of the House of Risk (HOR) approach for identifying and prioritizing risk sources in procurement processes. Vikaliana and Nazla (2024) demonstrated that the House of Risk approach could systematically map risk agents and support the development of mitigation strategies. Similar findings were reported by Illaritzqi, Istiqomah, and Albana (2024), who demonstrated that identifying risk agents could facilitate more targeted mitigation priorities in procurement processes. Regarding procurement performance measurement, Ottou et al. (2024) introduced the Procurement Delay Index as a quantitative measure of procurement schedule deviations and a means of identifying process bottlenecks. Meanwhile, Nugroho et al. (2020) stated that improving procurement process efficiency requires stronger coordination systems and

adequate resource management. Although previous studies have examined procurement risk identification and mitigation, much of the existing research has focused on risk prioritization without comprehensively mapping the actual business process structures from which these risks emerge. Furthermore, research specifically examining internal corporate procurement for air compressor system projects in manufacturing companies remains limited.

Based on these conditions, this study had two primary objectives. First, it aimed to analyze the existing business process structure for the internal corporate procurement of air compressor systems at PT X, including the process stages, allocation of organizational roles, and critical points that could contribute to procurement delays. Second, it aimed to identify the risks arising at each stage of the procurement cycle that could lead to delivery delays and contractual penalties. The findings were expected to provide a more comprehensive understanding of the sources of procurement delays and establish a basis for developing more effective procurement risk control mechanisms.

METHOD

This study employed a qualitative approach with a case study design focusing on the internal corporate procurement process for air compressor systems at PT X. The analysis examined the procurement business process structure, the involvement of organizational functions, and the risks arising at each stage of the procurement process.

Data were collected through document analysis, field observations, historical procurement project data from 2021–2024, and in-depth interviews with personnel directly involved in the procurement process. The informants represented project management, engineering, procurement, factory coordination, and logistics functions.

To address the first research objective, organizational documents, job descriptions, work procedures, and procurement project reports were analyzed using business process mapping. The actual procurement process at PT X was mapped to identify process stages, cross-functional relationships, information flows, and critical points associated with potential procurement delays.

Based on the business process mapping results, critical activities affecting procurement lead times were identified. Actual process performance was compared with the company's target procurement timelines to identify stages associated with potential bottlenecks and schedule deviations.

Risk identification was conducted with reference to the risk management principles outlined in the PMBOK Guide and ISO 31000. Risks identified at each procurement stage were analyzed according to their causes, potential consequences, and effects on procurement lead times and project delivery performance.

To address the second research objective, procurement risks were identified based on the business process mapping results, historical project data, project delay records, field observations, and cross-functional interviews. The identified risks were categorized according to the relevant procurement stages, including engineering validation, factory order placement, manufacturing, shipping arrangements, customs clearance, and final delivery.

The identified risks were further examined using historical project data and validated through interviews with personnel involved in the procurement process. This process was

used to assess the consistency of the identified risks with actual procurement conditions and historical delay patterns.

Data were analyzed using qualitative descriptive analysis. Data obtained from interviews, observations, historical records, and documents were triangulated to strengthen the credibility of the findings. Each identified risk was analyzed according to its underlying causes, effects on procurement lead times, and relationship with potential delivery delays and contractual penalties. The analysis resulted in a structured identification of procurement risks across the business process stages and provided a basis for determining the principal sources of delays in the internal corporate procurement of air compressor systems at PT X.

RESULTS AND DISCUSSION

1. Analysis of Existing Corporate Internal Procurement Business Processes

The research at this stage aims to map the actual conditions of the Internal Corporate procurement process at PT X. This mapping is needed to understand the existing workflow, analyze the clarity of roles between functions, and identify critical points (bottlenecks) that trigger delays in delivery before intervention in the form of improvements to the Standard Operating Procedure (SOP).

a. Actual Process Flow Mapping

Based on the results of data triangulation from internal company documents and respondent questionnaires, the current Internal Corporate procurement flow for Air Compressor System products was assessed by a staff member from the Sales & Marketing division as being systematic. This is reflected in his statement describing the flow as including: "Systematic submission of needs, approval, vendor selection process, PO creation, receipt of goods/services, to the payment process and vendor evaluation."

A similar view was expressed by another Sales & Marketing Staff who explained the actual chronology of the flow more specifically, namely: "It starts with the acceptance of a PO offer from the customer, processed by the sales admin to create an SO, then an order is placed with the factory, after the goods arrive at the warehouse, the goods are then sent to the customer."

In general, the operational process mapped from the perspective of practitioners in the field includes the following main stages:

1. Order Receiving: This stage begins entirely with the sales team. A member of the Sales & Marketing division stated that their primary task in this phase is to "Deliver PO > Create IOC and SO."
2. Planning & Engineering: The Project Team plays a crucial role in this phase. One Project Engineer explained that his involvement includes "Creating specifications/datasheets, technical evaluation, scoring," while another Project Engineer acts as "Determinant of material quantity, material items, design calculations."
3. Internal Approval: Requires validation, review, and signature of specification and budget documents before an order can be forwarded to the factory.
4. Order Booking / Procurement: The relevant team is responsible for executing orders, as stated by the Sales & Marketing Staff who are involved in the "Submit Purchase Order, Monitoring, Payment of Bills" activities.

5. Production and Assembly: The stage of confirming specifications and managing component productivity from raw material suppliers at the factory level.

Logistics and Shipping: The logistics team oversees the movement of goods. A member of the logistics division stated their responsibility to "ensure that goods from the warehouse are delivered to customers in good condition and arrive on time, according to the lead time specified by the forwarder."

b. Division of Roles and Responsibilities Across Divisions

Clarity of cross-divisional roles impacts the efficiency of procurement workflows. The majority of respondents stated that the current division of roles between functions within the company is rated "Quite Clear" to "Very Clear." For example, a member of staff from the Sales & Marketing division confirmed that the current process is "quite clear and follows established internal procedures and regulations."

However, several practitioners have expressed critical comments, stating that the division remains "unclear." This ambiguity specifically concerns the recording of approval policies and the "unclear job descriptions" that exist when coordinating internal teams for project completion. These gray areas in approval policies often lead to a buildup of administrative paperwork.

c. Identify Critical Points

Analysis of the existing process shows that although the procurement flow is already running, the lack of integrated cross-functional SOP standards triggers various critical points (bottlenecks) that are the root cause of delays. This picture is reinforced by a written explanation from the Sales & Marketing Staff who stated: "In my opinion, currently the Internal procurement process does not have fully consistent standards at every stage. Some processes still rely on manual coordination and the habits of each party... often experience bottlenecks, especially in the approval process, coordination between departments...".

This finding aligns with Schwalbe's (2019) opinion, which states that operational risks often arise from disjointed workflows and poorly documented and standardized internal processes. This situation makes it difficult for organizations to control cross-functional activities and increases the likelihood of process delays.

Based on direct testimony and evaluation from practitioners, procurement delays are predominantly concentrated in the following three operational stages:

1) Internal Approval Stage: Internal approval procedures are recognized as one of the biggest obstacles within organizations. According to practitioners, the root causes of delays at this stage are triggered by several factors, including:
   - Human resource aspects, such as the constraints of "busy approvers" and approval queues at the managerial level (Business Controller).
   - Technical aspects of engineering, such as the complexity of preparing "Detailed engineering design, where approval documents are required before fabrication".
   - The obstacles to bureaucratic decision-making systems are due to the many systems that must be passed through to obtain an approval decision.
2) Production / Assembly Stage (Factory Production) Constraints at the global factory level are heavily influenced by the stability of the supporting material supply chain. A staff member from the Sales & Marketing division highlighted that manufacturing delays often stem from "No available factory stock, have a lead time from the

supplier." This statement was reinforced by a supervisor from the Logistics division who confirmed that "the factory still has to wait for raw materials from the supplier." This deviation in the assembly schedule has a massive chain impact, as explained by a staff member from the Procurement division that: "the production process is behind schedule, resulting in a domino effect all the way to delivery to the end customer."

3) Logistics / Shipment Stage (Shipping and Customs)
   Logistics constraints are primarily caused by external factors beyond the direct control of company management that affect the delivery time of imported goods. Practitioners identify two main causes at this stage:
   - Global Geopolitical Factors: A staff member from the Logistics division stated that "geopolitical issues in the Strait of Hormuz are causing logistical delays because ships have to travel longer distances." A similar sentiment was confirmed by a staff member from the Operations division regarding "inter-state conflicts" that are disrupting shipping efficiency.
   - Customs Regulations: Administrative delays often occur at ports due to "customs clearance regulations" and the risk of delays in customs processes because "goods sometimes enter the red lane".

4) Suggestions for Improvement from Respondents
   To overcome the weaknesses in the existing system, the respondents provided several operational recommendations that will be integrated in the development of SOPs in this study, including:
   - Preparation of "written SOPs, which are socialized to all departments".
   - Carrying out "simplification of workflows, improvement of communication between teams, and optimization of monitoring systems to make processes more effective and transparent".
   - Evaluate the internal approval scheme so that its determination is "more adapted or less rigid to what actually happens"

2. Procurement Risk Identification

The research at this stage is focused on answering the second problem formulation, namely identifying what risks arise at each stage of the Internal Corporate procurement cycle at PT X that have the potential to cause delivery delays and project contractual penalties. This risk identification is the initial step in risk management (Risk Identification) which is compiled based on the results of business process mapping, analysis of historical project data, as well as questionnaire extraction and interviews with practitioners. Based on the established methodology, all risk findings are classified into five main stages of procurement.

Risk identification in this study is based on the risk management concept described in ISO 31000:2018 and PMBOK. According to ISO 31000:2018, risk is the effect of uncertainty on the achievement of organizational objectives, while PMI (2017) explains that project risk is an uncertain condition or event that can affect project objectives. In the context of PT X's Internal Corporate procurement, risks are primarily related to delivery delays, increased lead times, and potential contractual penalties that can impact project performance.

a. Risks in the Planning and Technical Specification Stage

The early stages of procurement are highly susceptible to technical risks related to specification compliance. Based on collected data, the most common risks during this phase

are incomplete technical specifications at the time of Purchase Order (PO) creation and a lack of synchronization between the Engineering and Sales teams.

Furthermore, obstacles often arise in determining detailed engineering designs, where approval documents are essential before the fabrication process can begin. Miscommunication, such as differing interpretations of price or order value, forces design revisions (rework), which directly delays further approval processes. Li et al. (2023) explain that design changes to complex products can trigger risk propagation across various project activities, including technical document revisions, production schedule changes, and increased lead times.

b. Risks at the Internal Approval Stage

Operational risks at this stage are directly related to the internal process governance of PT X. Late approvals are identified as one of the most critical risks that cause order schedules to be delayed.

The root of the problem at this stage is dominated by high workloads (reviewer overload) and the high level of activity of approvers. Furthermore, respondents highlighted that internal approval policies often require complex and rigid schemes, creating bureaucratic obstacles to managerial decision-making.

c. Risks at the Factory Ordering Stage

Once the documents are approved, the risk continues with the administrative transition process to the global factory. The primary risk at this stage is late delivery of the PO due to slow internal processes. This delay in placing an order (order input) triggers a potentially fatal derivative risk: the unavailability of production slots at the factory because the factory's capacity or scheduling commitments are already occupied by other projects. If production slots are full, procurement lead times will automatically increase significantly. This finding aligns with Burt et al. (2020), who explained that ordering activities to the global factory are highly rigid because they rely heavily on predetermined production schedules. Consequently, any delay in the ordering process can result in the loss of production slots and significantly extend procurement lead times.

d. Risks in Production and Sub-vendor Stages

As a complex engineered product, the Air Compressor System assembly process is highly dependent on the global supply chain. The primary manufacturing risk is the delay in the arrival of materials or components from sub-vendors. The factory has no available factory stock and is highly dependent on the lead time of raw material suppliers. Poor sub-vendor performance can disrupt the production schedule (including delays in the Factory Acceptance Test (FAT), which directly impacts the overall production process. This is in line with PMI (2017), which asserts that vendor and supplier delays are one of the most critical sources of risk in industrial projects because they can have a domino effect on subsequent project activities.

e. Risks at the Logistics and Customs Stage

International shipping logistics risks are extremely difficult to control because they are highly dependent on the stability of external factors. Risks at the logistics stage are also closely related to compliance with export and import regulations. Thai (2017) explains that export activities carry a high level of administrative and compliance risk because they

involve various documents, customs procedures, and regulatory requirements that differ in each destination country. Two dominant risks are identified at this stage:

1) Customs Risk: Incomplete shipping documents lead to goods being held at ports. Regulatory hurdles and customs inspection processes are further complicated when goods accidentally enter the "red lane."
2) Geopolitical and Shipping Risks: Conflicts between countries (such as the geopolitical issues in the Strait of Hormuz) force carriers to take longer, more detoured routes. This results in vessel delays, which directly impact potential fines (penalties) from customers due to units arriving late at project sites.

This finding aligns with research by Rahman and Kumaraswamy (2020), which shows that the delivery phase is one of the most critical stages for companies with tight delivery time commitments. Delays in this phase can directly impact customer satisfaction and increase the potential for contractual penalties. Furthermore, Smith and Keenan (2018) explain that liquidated damages (LD) are a protection mechanism used by customers to compensate for losses due to delays in project completion or delivery. Therefore, logistics risk management is a crucial aspect of PT X's internal corporate procurement management.

All risk findings from the process analysis and respondent interviews were synthesized and documented in the initial Risk Register, which can be seen in Table 1 below.

Table 2. Identification and Classification of Corporate Internal Procurement Risks

Code	Procurement Stages	Potential Risks	Root Cause	Initial Impact on Time
R1	Planning & Specifications	Technical specifications are not final / subject to change	Lack of synchronization between Engineering & Sales teams	*Rework*design and approval stage delays
R2	*Internal Approval*	*Engineering approval*/ late approval	High workload (reviewer overload) / complex bureaucratic scheme	*Order*to the factory delayed
R3	*Order Booking*	Factory production slots are full / not available	Delay in PO delivery due to slow internal process	*Lead time*increased processing
R4	Production & Sub-vendors	Delay in components from sub-vendors	No factory stock, dependence on imported materials, low sub-vendor performance	Delays in the production process and delays in the FAT schedule
R5	Logistics & Shipping	*Delay*shipping and customs clearance issues	Incomplete documents, goods are red-laned, and ship routes change due to geopolitics	Shipment held up, unit late to site, potential penalties

CONCLUSION

This study aimed to analyze the existing business process structure and identify the risks arising from the internal corporate procurement of air compressor systems at PT X. Based on the business process mapping results, the internal corporate procurement process comprised five main stages: technical planning and specification, internal approval, factory order placement, production and subvendor management, and logistics and delivery. These stages involved multiple interconnected organizational functions with a high degree of

interdependence; consequently, delays at one stage could affect subsequent activities and the overall procurement cycle. The business process analysis identified several critical points associated with potential procurement delays, particularly technical validation and approval, factory order placement, production monitoring, and logistics and delivery management. These findings indicate that effective cross-functional coordination, clearly defined process flows, and timely decision-making are critical to the successful internal corporate procurement of air compressor systems.

Furthermore, the risk identification results indicated that risks occurred throughout the procurement cycle and had varying effects on procurement lead times. Five major delay risks were identified: changes in technical specifications after procurement activities had commenced, delays in internal approvals, delayed factory order placement resulting in the loss of production slots, delays in component supply from subvendors, and disruptions to customs clearance and international shipping. These risks could extend procurement lead times, jeopardize project schedule targets, and increase exposure to contractual penalties resulting from late customer deliveries. Overall, this study provides an overview of the actual internal corporate procurement process for air compressor systems at PT X and the associated delay risks. The findings provide a basis for strengthening procurement process controls, improving cross-functional coordination, and developing more targeted risk mitigation measures to enhance delivery reliability and overall project performance.

REFERENCES

Andaru, R. G., & Adi, T. J. W. (2024). Risk analysis of e-procurement process of EPC construction project based on risk management. *Jurnal Indonesia Sosial Teknologi, 5*(3). https://doi.org/10.59141/jist.v5i3.985

Berger, N., Schulze-Scwering, S., Long, E., & Spinler, S. (2023). Risk management of supply chain disruptions: An epidemic modeling approach. *European Journal of Operational Research*, 304(3), 1036-1051. DOI: 10.1016/j.ejor.2022.05.018

Burt, D. N., Petcavage, S. D., & Pinkerton, R. L. (2020). *Supply Management* (9th ed.). McGraw-Hill Education.

Chopra, R., Sawant, L., Kodi, D., & Terkar, R. (2022). Utilization of ERP systems in manufacturing industry for productivity improvement. *Materials Today: Proceedings*, *62*, 1238–1245.

Handfield, R. B., & Nichols, E. L. (2019). *Introduction to supply chain Management* (2nd ed.). Pearson Education.

Hanira, E. M., & Djakman, C. D. (2026). An integrated risk management approach to delay risk in the procurement project of an accommodation work barge using FMEA method. *Owner: Riset dan Jurnal Akuntansi, 10*(1), 879–887. https://doi.org/10.33395/owner.v10i1.3007

Hauke-Lopes, A., Ratajczak-Mrozek, M., & Wieczerzycki, M. (2023). Value co-creation and co-destruction in the digital transformation of highly traditional companies. *Journal of Business & Industrial Marketing*, *38*(6), 1316–1331.

Illaritzqi, D., Istiqomah, S., & Albana, A, S. (2024). Analisis dan mitigasi risiko dalam pengadaan menggunakan pendekatan House of Risk pada perusahaan jaringan broadband. *Jurnal Penelitian Rumpun Ilmu Teknik, 3(3),* 98-116. DOI:10.55606/juprit.v3i3.4233

ISO. (2018). *ISO 31000: Risk Management – Guidelines*. International Organization for Standardization.

Kerzner, H. (2022). *Project Management: A systems approach to Planning, scheduling, and Controlling* (13th ed.). John Wiley & Sons.

Li, R., Yang, N., Yu, G., & Jin, N. (2023). The robustness of complex product development projects under design change risk propagation with gray attach information. *Reliability Engineering & system Safety, 25,* 109248. DOI: 10.1016/j.ress.2023.109248

Monczka, R. M., Handfield, R. B., Giunipero, L. C., & Patterson, J. L. (2020). *Purchasing and supply chain Management* (7th ed.). Cengage Learning.

Mushi, G. O., Ismail, I. J., & Mchopa, A. D. (2023). The influence of procurement skills on the cross-functional coordination in public procurement: evidence from Tanzania. *Cogent Sosial Sciences, 10(1),* 2324972. https://doi.org/10.1080/23311886.2024.2324972

Nugroho, M. Z. P., Nugroho, M. E., & Susanti, M. (2020). Study and Analysis of Delays in the Material Procurement Process: A case study of Steel Manufacturing Companies at Indonesia. *International Journal of Engineering Research and Advanced Technology*, 06(01), 01-08. DOI:10.31695/IJERAT.2020.3588

Ottou, J. A., Baiden, B. K., Nani, G., & Tuuli, M. M. (2024). Enhancing performance measurement of public procurement processes through the application of procurement delay index. *Heliyon, 10*(4), e25672. https://doi.org/10.1016/j.heliyon.2024.e25672

Rahman, M. M., & Kumaraswamy, M. (2020). *Procurement Delay*s and contractual penalties in EPC *Project*s. *Journal of Construction Engineering and Management*, 146(6), 04020045. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001845

Schwalbe, K. (2019). *Information technology Project Management* (9th ed.). Cengage Learning.

Smith, N. J., & Keenan, R. (2018). *Risk Management in construction Projects*. Wiley-Blackwell.

Thai, K. V. (2017). *International handbook of public procurement*. CRC Press.

Vikaliana, R., & Nazla, A. (2024). Analisis risiko dalam proses pengadaan barang di perusahaan perminyakan Indonesia menggunakan pendekatan House of Risk. *Jurnal InTent: Jurnal Industri dan Teknologi Terpadu, 7*(1), 33–40. https://doi.org/10.47080/intent.v7i1.3372

Voronova, O. (2022). Improvement of warehouse logistics based on the introduction of lean manufacturing principles. *Transportation Research Procedia*, *63*, 919–928.