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Strategic procurement in capital projects: risk, contract and supply management in CAPEX acquisitions

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ABSTRACT

Capital projects concentrate acquisitions of equipment, materials and services whose performance can simultaneously affect cost, schedule, quality and commissioning. This article examines strategic procurement in CAPEX acquisitions, focusing on the integration of supply planning, competitive sourcing, risk management, contracting and supplier performance. The study adopts a qualitative, exploratory and bibliographic-documentary approach. It distinguishes purchase price from total economic exposure and groups procurement risks into scope, supply market, schedule, quality, contract and interface risks. The roles of RFI, RFQ and RFP, contracting strategy, risk allocation and post-award governance are discussed. A stage-gate procurement model is proposed to connect commercial decisions with technical maturity and project schedule. The article concludes that CAPEX procurement creates greater value when involved early in planning and when traceability is maintained across requirements, selection, contract, expediting, change and closeout.

Keywords: procurement; CAPEX; capital projects; contracts; risk management; suppliers.

1 INTRODUCTION

Capital acquisitions differ from recurring purchases because they integrate technical, financial and contractual decisions that may remain linked to the asset for years. Long-lead equipment, engineering packages, construction works, installation and specialized services create dependencies among specifications, suppliers, logistics, schedules and commissioning.

In EPC projects and other capital-project configurations, procurement can become a channel through which risks are transmitted. Research on international EPC projects has identified relationships between procurement risks and impacts on cost, schedule and quality, showing that failures at one stage may trigger cascading effects (LI et al., 2022).

This article aims to examine how procurement can be structured as an integrating function in CAPEX projects. Its focus encompasses planning, sourcing strategy, RFX processes, supplier assessment, contracts, expediting, change management and performance indicators. It does not seek to prescribe a universal contracting method.

In capital projects, procurement also manages time. Long-lead equipment may need to be contracted before all project definitions are finalized, whereas premature purchases may lock in inappropriate requirements. The challenge is to decide which information must be mature at each gate so that early market engagement does not create unnecessary exposure.

Its interdisciplinary nature adds complexity. Engineering defines requirements and interfaces; planning links deliveries to the schedule; quality establishes inspections and acceptance criteria; finance controls budgets and

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cash flow; legal teams structure obligations; and logistics plans movement. Procurement operates where these decisions are communicated to the supply market and subsequently incorporated into contracts.

Accordingly, this article examines CAPEX procurement as a governance system for the acquisition life cycle. Rather than emphasizing any specific contract type, it considers mechanisms that preserve comparability, traceability, risk allocation and alignment between technical needs and commercial commitments.

2 METHODOLOGY

The study uses a qualitative, exploratory, bibliographic and documentary approach. It draws on academic literature concerning supply management, supplier selection, TCO and procurement risks in EPC, as well as institutional documents on supply-chain risk management published through January 31, 2026. The literature was organized according to the procurement cycle: planning, strategy, tendering, contracting, execution and closeout.

The analysis is conceptual. Examples involving RFI, RFQ, RFP, contracts and indicators are presented as governance instruments and must be adapted to each sector, jurisdiction, scope and organizational policy.

The review covers supply management and criticality; TCO; multicriteria assessment; procurement risk in EPC projects; supply-chain resilience; and supplier governance. The literature was selected for its relevance to the research problem and its ability to support the concepts used in the analytical model.

The documents were examined comparatively to identify relationships among scope maturity, RFX instruments, risk exposure, contractual structures and post-award performance. The analysis does not assume that one contractual arrangement or process suits every project.

The article uses RFI, RFQ and RFP as functional categories of market interaction. Their terminology and content may vary across companies and jurisdictions; the discussion therefore focuses on the purpose of each instrument rather than on universal standardization.

The figures and matrices are conceptual constructions developed by the author from the literature reviewed. They do not represent empirical data from a company or findings from field research. The documentary scope includes publications available through January 31, 2026, preserving the temporal traceability of references.

3 CAPEX PROCUREMENT AS A SYSTEM OF INTERFACES

A purchasing package originates from a technical need, but contracting depends on information maturity. Incomplete specifications may increase ambiguity, produce incomparable bids and transfer uncertainty into prices, contingencies or claims. Conversely, waiting for complete maturity may jeopardize long-lead items. Planning must balance technical definition with the need for early action.

Early procurement involvement makes it possible to map suppliers, identify lead times, test market capacity and inform make-or-buy, package and schedule decisions. This integration brings procurement closer to the supply-management logic proposed by Kraljic (1983): critical categories require strategies proportionate to their exposure.

In CAPEX, the engineering-commercial interface must preserve traceability. Technical requirements, acceptance criteria, required dates, warranties, documentation and responsibilities must remain consistent across

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requisitions, bid packages, bid equalization and contracts.

Breaking the project into contracting packages affects competition and accountability. Packages that are too broad may reduce the supplier pool and concentrate risk; excessive fragmentation increases interfaces, coordination needs and potential gaps. Strategy should balance market capacity, technical complexity and the organization's internal integration capability.

Long-lead items deserve differentiated treatment because their delivery times may determine the critical path. In such cases, early market consultations can validate capacity, manufacturing times, supplier engineering needs and raw-material availability.

This information can feed back into the schedule before a contractual commitment is made.

Interface governance also requires version control. Changes to specifications, drawings and dates must be consistently reflected in commercial documents. When suppliers quote different revisions, price comparisons lose validity and the risk of change orders increases.

4 RFI, RFQ AND RFP: DIFFERENT TOOLS FOR DIFFERENT UNCERTAINTIES

RFI, RFQ and RFP are not synonymous. An RFI is useful when the buyer needs to understand the market, capacity, technology or alternatives before finalizing a strategy. An RFQ is better suited to sufficiently defined scopes and specifications, allowing prices and terms to be compared. An RFP enables the evaluation of solutions and approaches when greater room exists for technical and commercial proposals.

Choosing the wrong instrument can create false competition. An RFQ issued with an immature scope tends to generate differing qualifications and assumptions, making the lowest price difficult to compare. Bid equalization must distinguish genuine price differences from differences in scope, taxes, logistics, delivery time, warranties and commercial terms.

The multicriteria assessment discussed by Ho, Xu and Dey (2010) provides a basis for combining cost with quality, delivery, capability and other criteria. In capital projects, weights and gates should be defined before commercial bids are opened whenever possible, reducing the risk of post hoc rationalization.

Instrument Primary use Expected outcome

RFI Explore market/capacity Strategic information

RFP Compare solutions Technical and commercial proposal

RFQ Compare a defined offer Comparable quotation

Negotiation Resolve gaps and trade-offs Documented final terms

Figure 1. Conceptual suitability of RFX instruments to the degree of definition. Source: prepared by the author.

An RFI can serve as a market-intelligence stage, particularly when the organization still needs to understand capacity, technological alternatives or supply constraints. Because it does not necessarily require a final offer, it can reduce information asymmetry before requirements and competition criteria are structured.

For an RFQ, comparability depends on scope stability. Commercial terms, applicable Incoterms, taxes, logistics, documentation, warranties and delivery times should be equalized so that differences in assumptions are not

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mistaken for differences in efficiency. A lower nominal price may simply reflect narrower scope coverage.

For an RFP, evaluation must distinguish technical merit, execution approach and commercial terms. This is particularly important when the supplier participates in defining the solution. Predetermined criteria and evaluation governance help reduce subjectivity and make award recommendations more auditable.

5 PROCUREMENT RISK AND ITS TRANSMISSION TO THE PROJECT

Li et al. (2022) examine procurement risks in international EPC projects and show that risk factors can be interconnected and transmit effects throughout a project. The managerial implication is that purchasing risks should not remain confined to a departmental spreadsheet; they need to be linked to the project's risk register and schedule.

Scope risks include incomplete specifications, late changes and documentary inconsistencies. Market risks include limited competition, concentration, capacity constraints and volatility. Schedule risks cover supplier engineering, manufacturing, inspection, transportation and document release. Contractual risks include inappropriate allocation of responsibilities, unclear change mechanisms and warranties that do not match the exposure.

Responses may include prequalification, alternative suppliers, contractual milestones, inspections, expediting, capacity reservations, selective buffers, insurance and contingency plans. The response should be proportionate to the risk, since excessive controls also entail costs.

Li et al. (2022) emphasize that procurement risks can form transmission chains. A delay in supplier engineering, for example, may postpone manufacturing, inspection, transportation, assembly and commissioning. Assessing each event in isolation can underestimate systemic consequences when dependencies are not mapped.

Risk prioritization should consider detectability and lead time in addition to likelihood and impact. Some deviations can be detected early through documentation or manufacturing milestones; others only become visible near delivery. Leading indicators, such as late drawings or low factory productivity, may allow intervention before the final contractual milestone is missed.

Risk responses need an owner and a deadline. Recording a risk without an associated action, responsible person and trigger produces documentation without effective control. Procurement may coordinate commercial and supplier responses, but technical, logistical and project risks often require shared accountability.

6 TCO AND ECONOMIC DECISION-MAKING IN CAPEX

The equipment price represents only part of its economic impact. Ellram (1995) and Wouters, Anderson and Wynstra (2005) show that total cost of ownership (TCO) extends the analysis to costs associated with acquisition and use. In CAPEX, depending on the asset, these may include freight, applicable taxes, inspection, installation, training, spare parts, maintenance, consumption, downtime and disposal.

The analysis must avoid double counting and inconsistent assumptions. Future costs should use a common time horizon, currency and financial criteria. When alternatives have different service lives or maintenance profiles, initial price becomes less informative.

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TCO does not replace the project's business case. It serves as an additional layer for comparing acquisition alternatives, whereas the business case incorporates the benefits and economic flows of the investment as a whole.

For long-lived assets, small differences in efficiency, maintenance or availability may outweigh substantial differences in initial price. It is therefore necessary to define the time horizon and usage assumptions before comparison. Without a common basis, technically different proposals may generate incomparable TCO figures.

The model must distinguish certain costs from expected costs. Contracted freight and spare-part prices may be known; future downtime and failures depend on probabilities. Combining these without making uncertainty explicit creates a total that appears objective but contains assumptions of different kinds.

Sensitivity analysis is especially useful when the award decision changes according to utilization rates, energy prices, useful life or maintenance frequency. Rather than concealing this instability, decision-making should show which variables drive the result and which scenarios make one alternative preferable.

7 THE CONTRACT AS A GOVERNANCE ARCHITECTURE

A contract transforms sourcing decisions into verifiable obligations. Scope, deliverables, acceptance criteria, milestones, responsibilities, change management, warranties and communication mechanisms must reflect the package's actual risks. Formally transferring a risk to the supplier does not guarantee that the supplier can manage it; it may merely raise prices or create future disputes.

Efficient allocation places each risk with the party best able to control its probability or consequences. In complex contracts, interface clarity is particularly important: a gap between the equipment supplier, installer, engineering team and operator can generate costs even when each contract appears complete in isolation.

Post-award governance includes kick-off meetings, submittals, document approvals, inspections, expediting, progress meetings, nonconformity management and change control. Procurement remains relevant after a purchase order is issued because economic exposure remains open until delivery, acceptance and closeout.

Change clauses deserve attention because capital projects evolve. Contracts should define how changes are requested, evaluated, priced and approved, maintaining a documentary trail. Without such a mechanism, informal instructions can turn into disputes over scope and responsibility.

Acceptance criteria must also be verifiable. Generic expressions such as “according to specification” are insufficient where tests, documents, inspections or guaranteed performance are involved. Linking specifications, inspection and test plans, payment milestones and acceptance reduces ambiguity during execution.

Contract governance should not rely solely on penalties. Incentives, communication, escalation and timely resolution of deviations may be more effective in protecting schedules. Contracts structure rights and obligations, but active management determines how these mechanisms work in practice.

8 STAGE-GATES FOR CAPITAL PROCUREMENT

Gate Key question Minimum evidence

G0 Need What needs to be purchased? Business need + owner

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G1 Strategy How will the market be approached? Scope, market, risk, schedule

G2 Bid Are bids comparable? Technical/commercial equalization

G3 Award Is the decision defensible? TCO, risk, approvals

G4 Execution Is the supplier performing? Milestones, quality, expediting

G5 Closeout Have obligations been fulfilled? Acceptance, documents, warranties, claims

Figure 2. Conceptual stage-gate model for CAPEX procurement. Source: prepared by the author based on the literature reviewed.

The stage-gate model creates explicit decision points without imposing uniform bureaucracy. Low-criticality packages may use simplified gates, while critical or long-lead equipment may require additional evidence. The principle is to prevent a commercial stage from advancing without the minimum information appropriate to the exposure being assumed.

An initial gate may confirm the need, budget, criticality and package strategy before approaching the market. A second may validate bid-package maturity and the supplier list. A third may confirm technical and commercial equalization before award. Subsequent gates may track manufacturing, delivery, acceptance and closeout.

The evidence required at each gate should be proportionate to exposure. Approval may be straightforward for a standardized item; critical equipment may require a technical opinion, risk analysis, TCO, inspection plan and legal validation. Proportionality prevents governance from becoming undifferentiated bureaucracy.

Gates also provide decision points for stopping or redirecting an acquisition. If the market cannot confirm timing, capacity or a solution, the project can revisit scope, package strategy or schedule before making a commitment. This reduces the cost of discovering incompatibilities only after award.

Governance must specify who makes decisions and which exceptions are allowed. A gate without clear authority may become merely a checklist. When early action is necessary, an exception should document the accepted risk, accountable person and mitigation plan, preserving speed without sacrificing traceability.

The value of stage-gates lies in the quality of information available at decision points. Lengthy documents cannot compensate for outdated assumptions. Each gate should therefore prioritize evidence that can change the decision: scope maturity, financial exposure, supplier capacity, schedule and residual risks.

9 INDICATORS AND PERFORMANCE GOVERNANCE

CAPEX procurement indicators must distinguish activity from outcomes. The number of quotations or the time required to issue a purchase order measures process activity but does not, by itself, demonstrate project value. More outcome-oriented indicators include adherence to the required-on-site date, cost variation attributable to changes, first-inspection quality, nonconformity resolution time and supplier predictability.

Savings also require a definition. Comparing an award with the initial quotation may overstate value when scope has changed. Baselines must be documented. In capital projects, preventing delays, reducing exposure or improving warranties can create value even without a nominal price reduction.

Post-project review closes the learning cycle. Data on suppliers, deviations, claims, changes and causes of delays can inform future category strategies and qualification processes.

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Leading and lagging indicators should coexist. Final on-time delivery is an outcome; drawing approvals, manufacturing progress and closure of quality actions are earlier signals that allow intervention. Combining both reduces dependence on metrics that merely confirm a delay when it is already too late to correct it.

Performance governance should establish the source, frequency and owner of each indicator. Metrics without shared definitions lead to debates about numbers instead of decisions about deviations. Baselines and calculation rules are especially important for savings, schedule adherence and scope variation.

Supplier performance records should be accumulated so that they can inform future decisions. A supplier that finishes a project with recurring delays or a high incidence of nonconformities should not enter the next sourcing process as though no history existed. Contract closeout should feed back into supplier qualification and category strategy.

10 DISCUSSION

The main contribution of this integrated approach is to treat procurement as a coordination mechanism between technical and commercial decisions. This reduces the tendency to assess purchasing solely by negotiation outcomes and shows that much value is created before the RFQ and after award.

There are, however, limitations. Risk models and scorecards depend on data and judgment. Contracts do not eliminate uncertainty. TCO cannot adequately monetize every factor. Governance must therefore combine metrics, gates and professional judgment while preserving the decision trail.

The contemporary context of supply-chain resilience reinforces the importance of mapping dependencies. The OECD (2025) recommends navigating risks without assuming that complete relocation is an automatic solution. In CAPEX, this view favors calibrated strategies for suppliers, inventories, capacity and contingencies rather than uniform responses.

The analysis suggests that CAPEX procurement creates value primarily by reducing misalignment. A competitive quotation cannot compensate for ambiguous specifications, an infeasible schedule or a contract disconnected from risk.

A substantial share of performance is determined before negotiation, when scope, packages, criteria and market strategy are defined.

Another implication is that controls should vary with criticality. Applying the same procedures to every package increases administrative costs without necessarily reducing risk. The segmentation proposed by Kraljic (1983) provides a basis for differentiating the depth of analysis and intensity of governance.

The model also demonstrates that post-award activities continue the sourcing process. Expediting, inspections, change management and performance assessment are not disconnected from supplier selection; they test the assumptions underlying the award and generate data for future decisions.

CONCLUSION

Strategic procurement in capital projects should be understood as a process of managing interfaces and risks throughout the acquisition life cycle. Early planning, appropriate RFX selection, bid equalization, TCO, multicriteria assessment, coherent contracting, expediting and closeout form an integrated system. When these

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stages are fragmented, scope differences, delays and changes can turn apparent savings into project costs. The proposed stage-gate structure does not seek to create bureaucracy but to ensure that relevant decisions are made with information proportionate to exposure. CAPEX procurement value therefore lies in combining competition, economic discipline, contractual clarity and execution continuity.

The study showed that CAPEX procurement cannot be reduced to obtaining quotations and issuing orders. Its function is to connect technical definition, supply markets, economics, contracts, risks and execution throughout a cycle in which early decisions determine subsequent costs and schedules.

The first conclusion is that scope maturity and RFX instrument selection are directly related. RFI, RFQ and RFP serve different purposes, and their use should reflect the degree of uncertainty. Competition without comparability can create the appearance of savings that disappear during execution.

The second conclusion is that procurement risks must be managed as project risks. Delays in engineering, manufacturing, inspection or logistics can transmit effects to subsequent activities. Integrating registers, accountable parties and triggers enables proactive responses instead of merely managing consequences.

The third conclusion is that TCO improves the quality of economic decisions in CAPEX. Initial price remains relevant but does not alone represent the costs of installation, operation, maintenance,

quality and downtime. Shared assumptions and sensitivity analysis are needed to avoid false precision.

The fourth conclusion is that contracts and post-award governance are inseparable. Clauses addressing scope, changes, acceptance, warranties and milestones must reflect risks that can be managed. After award, indicators, expediting, inspections and change management verify whether the contracted solution remains aligned with project objectives.

The proposed stage-gate model organizes decision points without assuming uniform bureaucracy. Its application should be proportionate to criticality and exposure. Gates are useful when they prevent progress with insufficient information and consciously document exceptions required by the schedule.

As a limitation, the article is bibliographic and documentary in nature and does not empirically measure project performance. Future research may test the model in different industries, compare packages of varying criticality and assess relationships among scope maturity, contractual changes, schedule and TCO.

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